

Sacramento River Temperature Task Group Meeting

April 25, 2019 | 1:00 pm – 3:00 pm

Location JOC – Joint Operations Center, 3310 El Camino Ave, Sacramento CA 95821

Conference Line: 877-417-6209

Participant code: 1593030

Agenda

- Introductions
- Meeting Purpose and Overview
- Fishery update
- Hydrology & Operations update (information is available on web-pages)
 - Daily Operation
 - Summary
 - 8-Station Index and Snow Water Content
 - Operations Outlook
 - Mean Daily Water Temperatures
 - Redding 10-Day Forecasted Air Temperatures
 - Sac River Gage temp plot and air temp plot
 - Lake Shasta Isothermobath Plot
 - Lake Shasta Isotherm Statistics Plots
 - Lake Shasta Current TCD Configuration
 - Trinity Lake Isothermobath Plot
 - Whiskeytown Lake Isothermobath Plot
- Temperature Studies
 - 90% Runoff Exceedance: 25% and 50% L3MTO Meteorology
 - 50% Runoff Exceedance: 25% and 50% L3MTO Meteorology
 - Cold Water Pool Tracking
- Updates
- Next Meeting: May 23, 2019

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. BUREAU OF RECLAMATION-CENTRAL VALLEY PROJECT-CALIFORNIA

DAILY CVP WATER SUPPLY REPORT

APRIL 23, 2019

RUN DATE: April 24, 2019

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2018	WY 2019	15 YR MEDIAN
TRINITY	LEWISTON	375	2,357	506
SACRAMENTO	KESWICK	4,278	8,202	5,831
FEATHER	OROVILLE (SWP)	1,300	10,500	2,300
AMERICAN	NIMBUS	2,346	6,850	2,346
STANISLAUS	GOODWIN	1,504	4,028	1,501
SAN JOAQUIN	FRIANT	380	509	380

STORAGE IN MAJOR RESERVOIRS IN THOUSANDS OF ACRE-FEET

RESERVOIR	CAPACITY	15 YR AVG	WY 2018	WY 2019	% OF 15 YR AVG
TRINITY	2,448	1,850	1,931	2,181	118
SHASTA	4,552	3,774	4,193	4,107	109
FOLSOM	977	726	815	838	115
NEW MELONES	2,420	1,552	2,058	1,927	124
FED. SAN LUIS	966	743	898	924	124
TOTAL NORTH CVP	11,363	8,644	9,895	9,977	115
MILLERTON	520	321	456	279	87
OROVILLE (SWP)	3,538	2,641	2,361	3,151	119

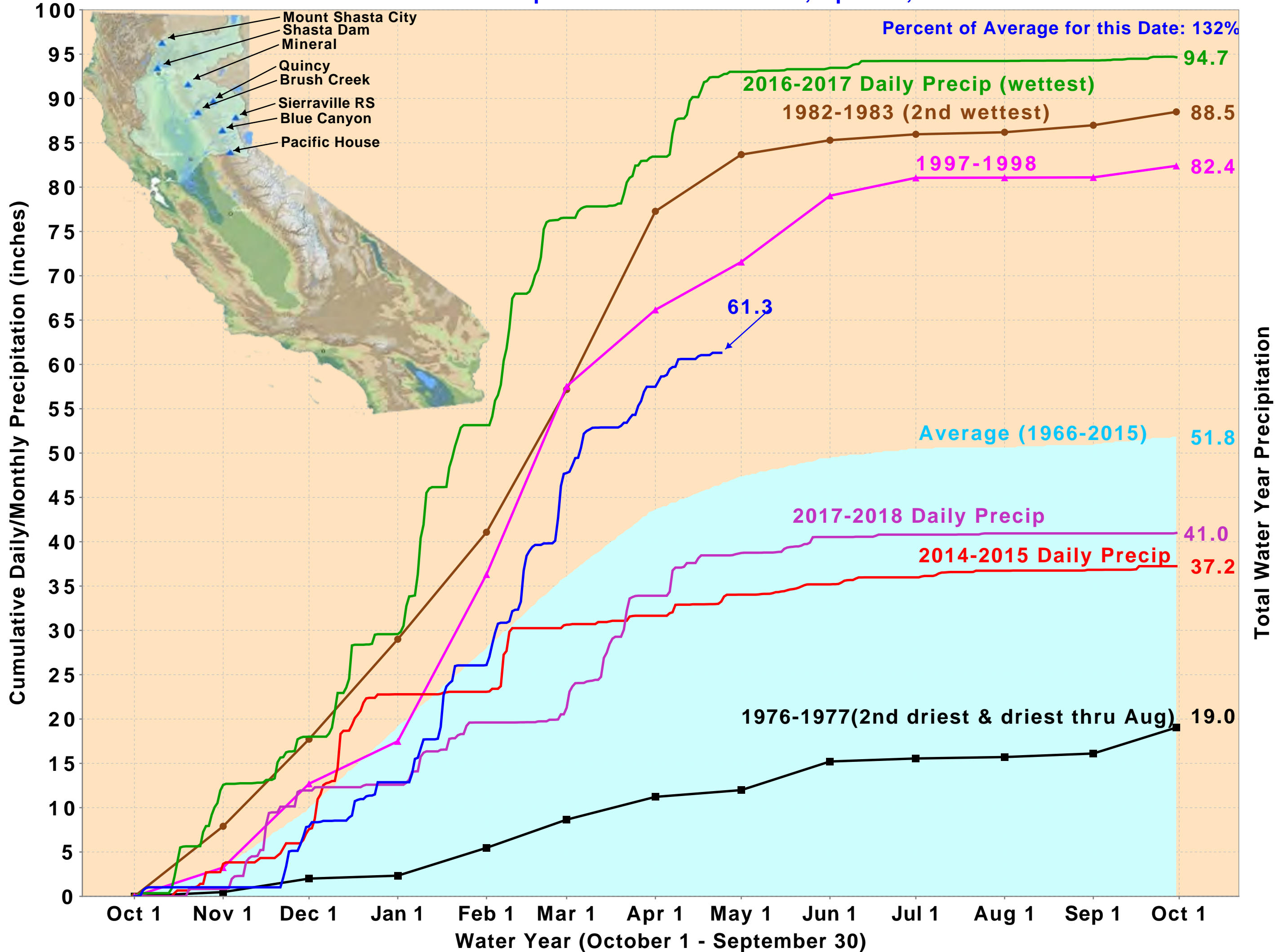
ACCUMULATED INFLOW FOR WATER YEAR TO DATE IN THOUSANDS OF ACRE-FEET

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	936	106	1,422	757	124
SHASTA	5,222	1,550	7,856	3,799	137
FOLSOM	2,361	222	3,988	1,791	132
NEW MELONES	770	---	1,261	594	130
MILLERTON	844	117	1,857	647	130

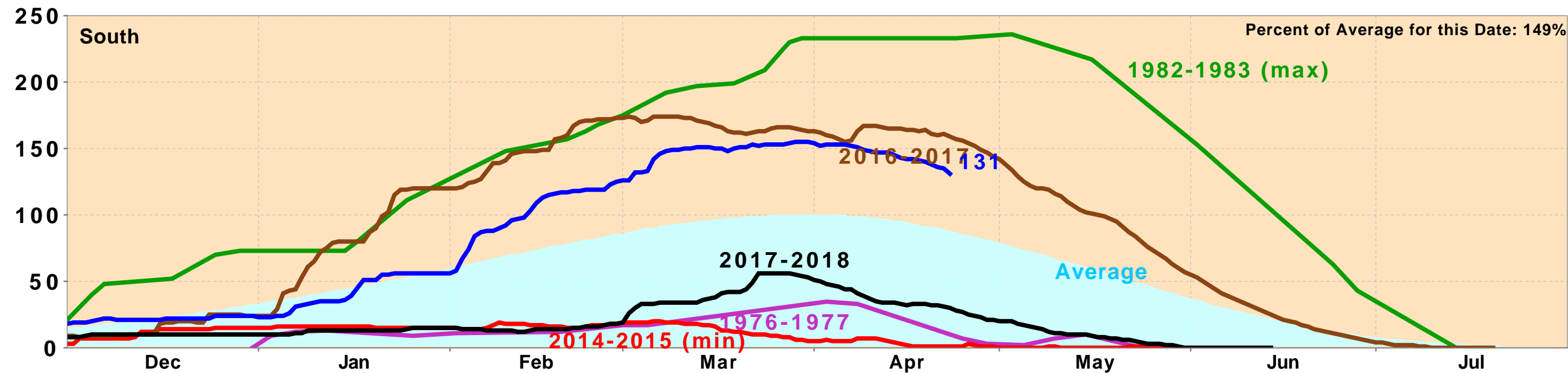
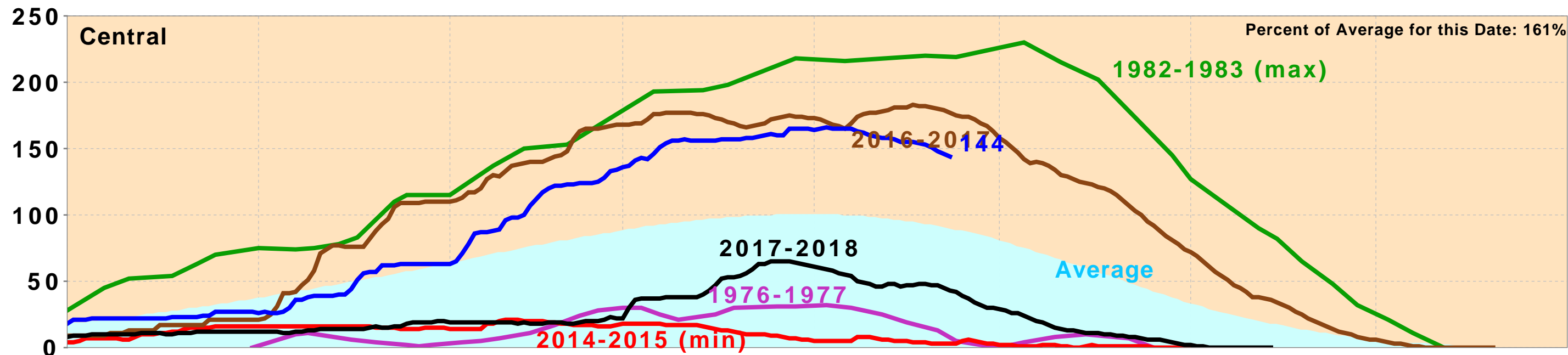
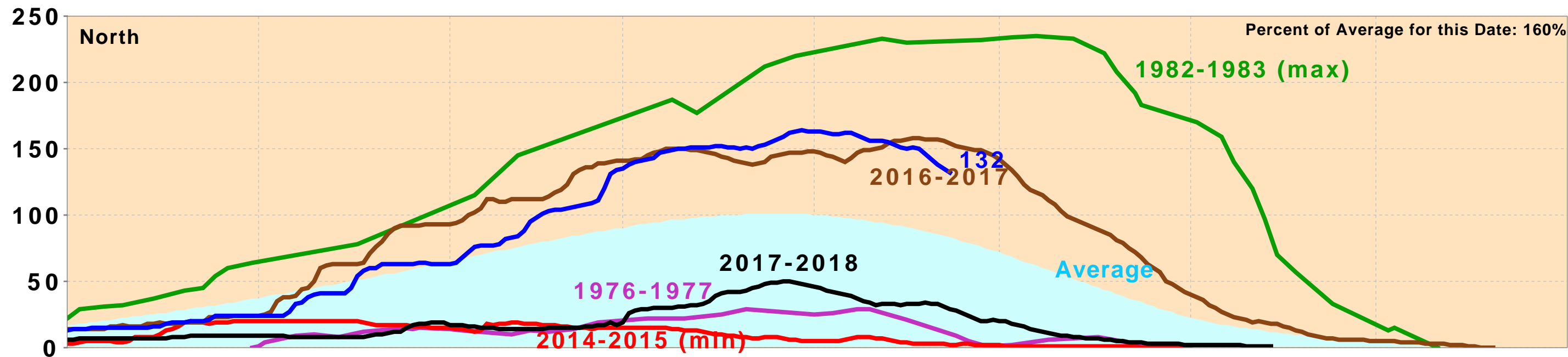
ACCUMULATED PRECIPITATION FOR WATER YEAR TO DATE IN INCHES

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	AVG (N YRS)	% OF AVG	LAST 24 HRS
TRINITY AT FISH HATCHERY	34.63	9.27	51.97	29.02 (57)	119	0.00
SACRAMENTO AT SHASTA DAM	80.41	11.04	104.96	56.89 (62)	141	0.00
AMERICAN AT BLUE CANYON	80.19	15.64	96.24	61.18 (44)	131	0.00
STANISLAUS AT NEW MELONES	37.88	---	42.10	25.48 (41)	149	0.00
SAN JOAQUIN AT HUNTINGTON LK	50.56	11.50	75.30	38.09 (44)	133	0.00

Northern Sierra Precipitation: 8-Station Index, April 24, 2019



California Snow Water Content, April 23, 2019, Percent of April 1 Average



Statewide Percent of April 1: 137%

Statewide Percent of Average for Date: 157%

Upper Sacramento River Summary Conditions – April (On-going):

Storage/Release Management Conditions:

- Reservoir Inflow Uncertainty: Meteorological projections: Shorter term forecasts (8-14 day) suggest increased chances of precipitation
- Longer term forecasts (one-month outlook) suggest equal chances of above or below precipitation
- Current Lake Shasta encroachment into the USACE flood space: 22%, encroachment is expected to decrease in the short term. Shasta Lake is in a spring refill condition under the USACE flood control diagram.
- Current release from Keswick Dam: 8,000 cfs and decreasing to 5,500 cfs 4/28 for ACID flashboard installation, gravel injection/in-river habitat management/other in-river work

Temperature Management:

- Temperature management: Active management has concluded for the season. Seasonal warming is controlling water temperatures
- Temporary instream warming as a result of lower flows (for “in-river” work activities) and record ambient air temperatures this week; next week ambient air temperature is expected to cool
- Selective withdrawal: Releases are made from Upper Gates – rebuilding cold water pool reserves
- Meteorological Uncertainty: Shorter term forecasts (8-14 day) suggest normal temperatures
- Longer term forecasts (one-month outlook) suggest above normal chances of warmer temperatures

Resources:

- Excellent link for short term precipitation forecasts, overlay with burn areas, debris flow potential, etc: <https://www.cnrfc.noaa.gov/>
- Comprehensive Upper Sacramento fishery information: <https://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/CDFWUpperSacRiverBasinSalmonidMonitoring.aspx>

CVP Northern System Operation Outlooks

DRAFT April 2019

90% Runoff Exceedance Outlook:

Inflow based on DWR B120 90%; Historical Inflows Oct and future months

Federal End of the Month Storage/Elevation (TAF/Feet)

		Apr	May	Jun	Jul	Aug	Sep	Oct
Shasta	4028	4235	4328	4082	3653	3192	2896	2719
Elev.		1056	1059	1051	1035	1016	1003	995

Monthly River Releases (cfs)

Sacramento	15000	8500	10500	12000	12000	9000	7000
Clear Creek	218	216	288	150	150	150	200

Trinity Diversions (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct
Carr Power Plant	30	17	45	100	101	70	18
Spring Creek PP	10	10	30	90	90	60	40

Please note:

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.

CVP operational forecasts or outlooks consider general system-wide dynamics and do not necessarily address specific watershed/tributary details.

CVP releases represent monthly averages.

CVP operations are updated monthly as new hydrology information is made available December through May.

50% Runoff Exceedance Outlook:

Inflow based on DWR B120 50%; Historical Inflows Oct and future months

Federal End of the Month Storage/Elevation (TAF/Feet)

		Apr	May	Jun	Jul	Aug	Sep	Oct
Shasta	4028	4235	4448	4301	3947	3464	3198	3036
Elev.		1056	1063	1058	1046	1027	1016	1009

Monthly River Releases (cfs)

Sacramento	15000	8500	10000	11500	13000	9500	7000
Clear Creek	218	216	288	150	150	150	200

Trinity Diversions (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct
Carr Power Plant	21	9	41	99	100	89	13
Spring Creek PP	10	10	30	90	90	80	35

Estimated CVP Operations 90% Exceedance
65% Ag, 90% M

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Trinity	1932	2061	2153	2176	2059	1906	1786	1754	1735	1744	1776	1861	1938
	Elev.	2345	2351	2353	2345	2334	2326	2323	2322	2322	2325	2331	2337
Whiskeytown	216	238	238	238	238	238	238	206	206	206	206	206	206
	Elev.	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199	1199
Shasta	4028	4235	4328	4082	3653	3192	2896	2719	2684	2737	2888	3193	3622
	Elev.	1056	1059	1051	1035	1016	1003	995	993	996	1003	1016	1033
Folsom	735	871	932	966	852	667	611	522	443	382	383	444	593
	Elev.	456	462	465	454	436	430	419	409	400	400	409	428
New Melones	2001	1890	1931	1961	1897	1824	1780	1731	1736	1744	1748	1755	1689
	Elev.	1042	1046	1049	1043	1036	1032	1027	1027	1028	1029	1029	1023
San Luis	965	830	591	419	190	59	49	-44	66	278	431	525	651
	Elev.	519	481	451	432	423	411	381	397	435	460	473	487
Total		10125	10172	9843	8889	7886	7360	6888	6869	7091	7432	7983	8698

Monthly River Releases (TAF/cfs)

Trinity	TAF	136	197	133	66	53	52	23	18	18	18	17	18
	cfs	2,286	3,204	2,235	1,073	857	870	373	300	300	300	300	300
Clear Creek	TAF	13	13	17	9	9	9	12	12	12	12	11	12
	cfs	218	216	288	150	150	150	200	200	200	200	200	200
Sacramento	TAF	892	523	625	738	738	535	430	297	277	246	222	246
	cfs	15000	8500	10500	12000	12000	9000	7000	5000	4500	4000	4000	4000
American	TAF	446	369	238	223	286	149	123	119	123	111	100	92
	cfs	7500	6000	4000	3634	4653	2500	2000	2000	2000	1800	1800	1500
Stanislaus	TAF	222	123	65	26	25	24	52	18	18	22	20	101
	cfs	3734	2001	1100	429	400	400	842	300	300	358	364	1648

Trinity Diversions (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Carr PP	30	17	45	100	101	70	18	21	12	3	2	35
Spring Crk. PP	10	10	30	90	90	60	40	15	12	10	20	50

Delta Summary (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Tracy	77	61	255	268	268	229	60	187	270	220	200	258
USBR Banks	0	0	0	26	26	26	0	0	0	0	0	0
Contra Costa	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7
Total USBR	89	74	265	305	307	269	77	205	288	234	214	271
COA Balance	0	0	0	0	0	0	0	0	0	0	0	0
Old/Middle River Std.												
Old/Middle R. calc.	1,505	929	-5,149	-8,463	-8,050	-5,134	-1,656	-5,003	-6,611	-4,903	-5,045	-5,033
Computed DOI	62817	27134	12305	8004	10004	13784	12282	5850	6946	11891	11545	13941
Excess Outflow	35384	7694	303	0	0	773	878	0	2440	5889	144	2538
% Export/Inflow	3%	6%	32%	48%	43%	29%	13%	47%	54%	36%	37%	34%
% Export/Inflow std.	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%	35%

Hydrology

Water Year Inflow (TAF)	Trinity	Shasta	Folsom	New Melones
Year to Date + Forecasted % of mean	1506 125%	6,804 123%	3,598 132%	1483 140%

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CVP releases or export values represent monthly averages.

CVP Operations are updated monthly as new hydrology information is made available December through May.

Estimated CVP Operations 50% Exceedance

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Trinity	1932	2070	2227	2269	2158	2012	1875	1849	1836	1863	1927	2037	2121
	Elev.	2346	2356	2359	2352	2342	2332	2330	2329	2331	2336	2343	2349
Whiskeytown	216	238	238	238	238	238	238	206	206	206	206	206	206
	Elev.	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199	1199
Shasta	4028	4235	4448	4301	3947	3464	3198	3036	2995	3081	3195	3513	3773
	Elev.	1056	1063	1058	1046	1027	1016	1009	1008	1011	1016	1029	1039
Folsom	735	841	927	938	904	715	704	625	595	584	581	593	750
	Elev.	453	461	462	459	441	440	431	428	427	426	428	444
New Melones	2001	1898	1998	2090	2034	1980	1945	1901	1912	1929	1954	2000	1969
	Elev.	1043	1052	1060	1055	1050	1047	1043	1044	1046	1048	1052	1049
San Luis	965	868	644	451	212	74	91	85	118	317	481	601	724
	Elev.	520	481	452	434	415	425	407	399	434	462	475	488
Total		10150	10482	10288	9492	8482	8052	7701	7662	7980	8344	8949	9543

Monthly River Releases (TAF/cfs)

Trinity	TAF	136	197	133	66	53	52	23	18	18	18	17	18
	cfs	2,286	3,204	2,235	1,073	857	870	373	300	300	300	300	300
Clear Creek	TAF	13	13	17	9	9	9	12	12	12	15	11	12
	cfs	218	216	288	150	150	150	200	200	200	240	200	200
Sacramento	TAF	892	523	595	707	799	565	430	357	307	492	444	615
	cfs	15000	8500	10000	11500	13000	9500	7000	6000	5000	8000	8000	10000
American	TAF	476	553	357	184	297	119	154	119	123	154	250	154
	cfs	8000	9000	6000	3000	4835	2000	2500	2000	2000	2500	4500	2500
Stanislaus	TAF	222	123	65	61	25	24	52	18	18	22	20	101
	cfs	3734	2001	1100	1000	400	400	842	300	300	358	364	1648

Trinity Diversions (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Carr PP	21	9	41	99	100	89	13	25	12	0	2	45
Spring Crk. PP	10	10	30	90	90	80	35	20	15	20	35	70

Delta Summary (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Tracy	122	86	258	270	268	258	149	114	260	235	230	260
USBR Banks	0	0	0	31	31	31	0	0	0	0	0	0
Contra Costa	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7
Total USBR	134	99	268	312	312	303	166	132	278	249	244	273
COA Balance	0	0	0	0	0	0	0	0	0	0	0	0
Old/Middle River Std.												
Old/Middle R. calc.	2,773	1,589	-5,753	-8,895	-7,687	-8,189	-3,006	-2,805	-6,532	-4,971	-4,975	-5,068
Computed DOI	72500	41921	17566	8313	12998	12271	12819	11397	10183	20415	26853	32307
Excess Outflow	45066	16153	1412	309	0	874	1415	0	5677	14413	15453	20903
% Export/Inflow	4%	5%	29%	49%	37%	42%	22%	23%	45%	25%	21%	19%
% Export/Inflow std.	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%	35%

Hydrology

Water Year Inflow (TAF)	Trinity	Shasta	Folsom	New Melones
Year to Date + Forecasted % of mean	1592 132%	7,119 129%	3,967 146%	1661 157%

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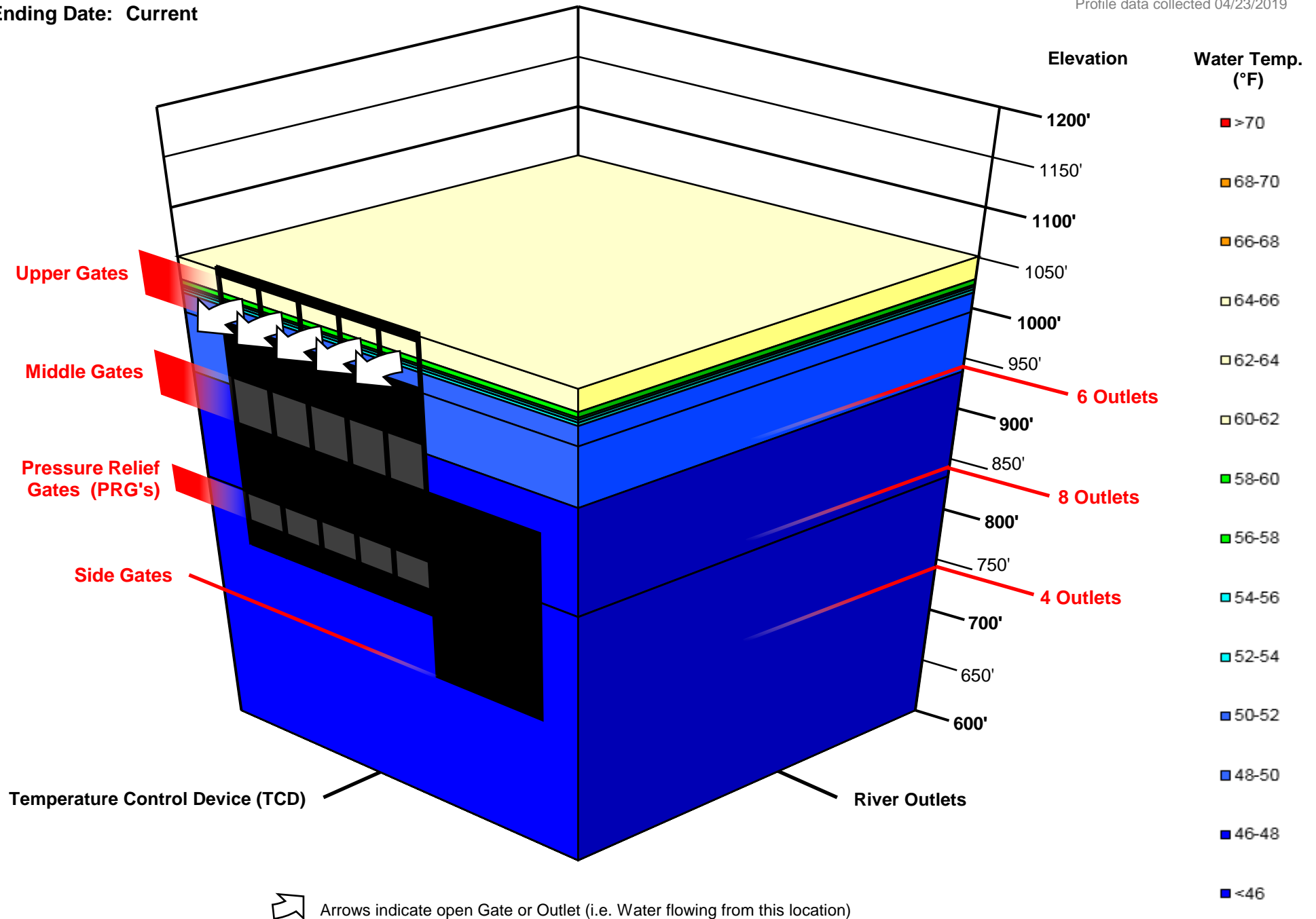
CVP Operations are updated monthly as new hydrology information is made available December through May.

Shasta TCD Configuration

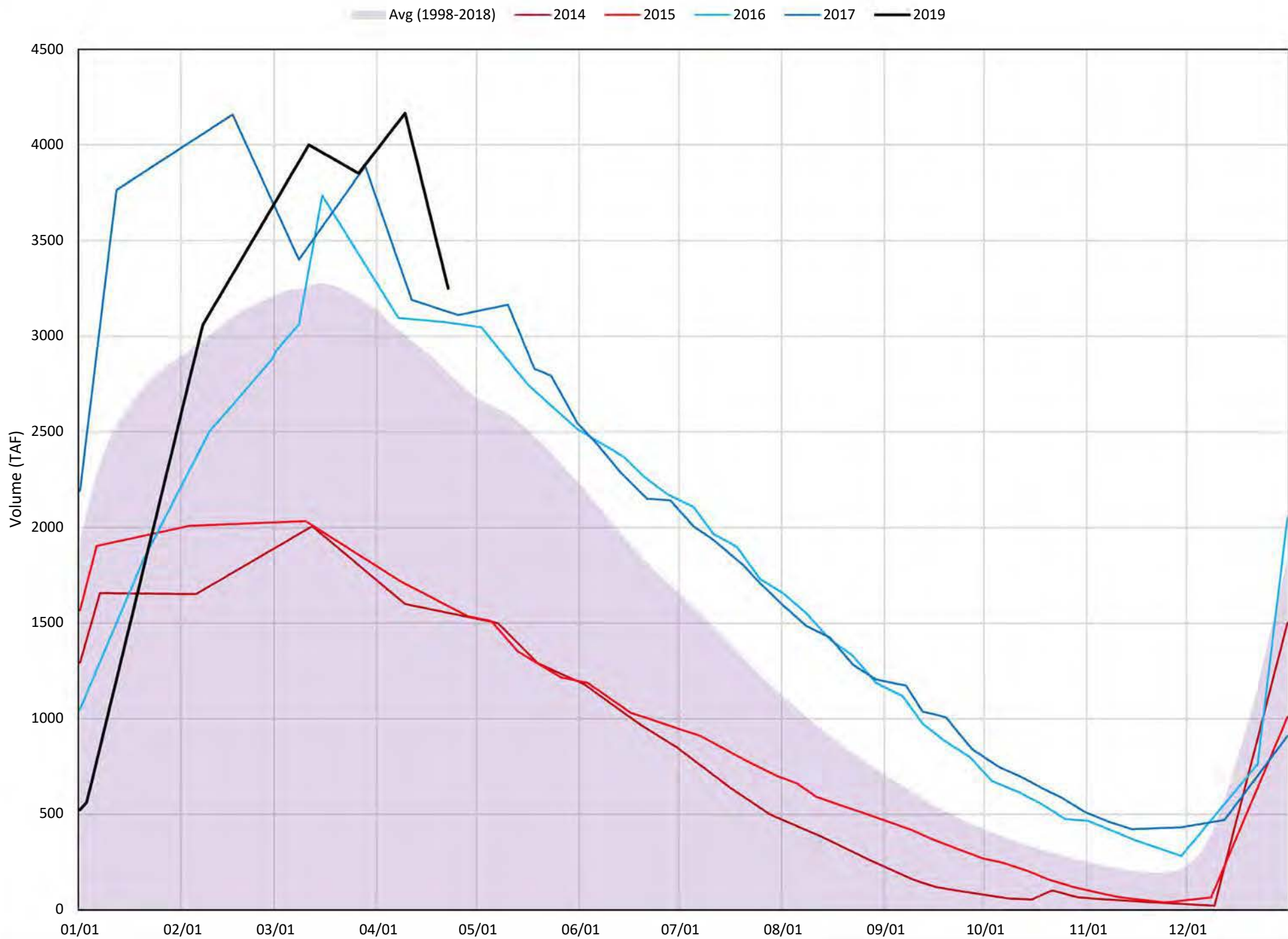
Starting Date: 04/17/2019

Ending Date: Current

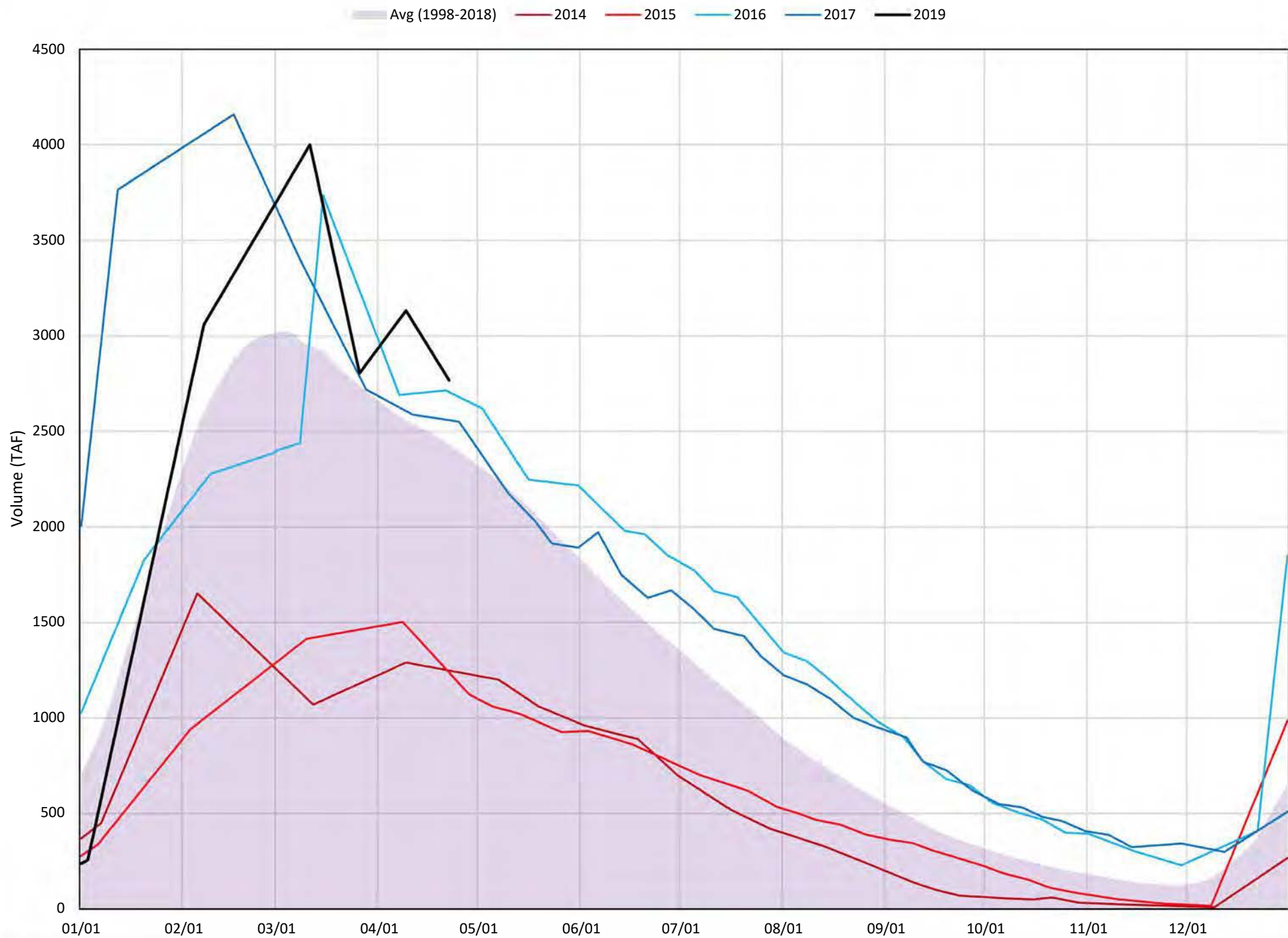
Profile data collected 04/23/2019



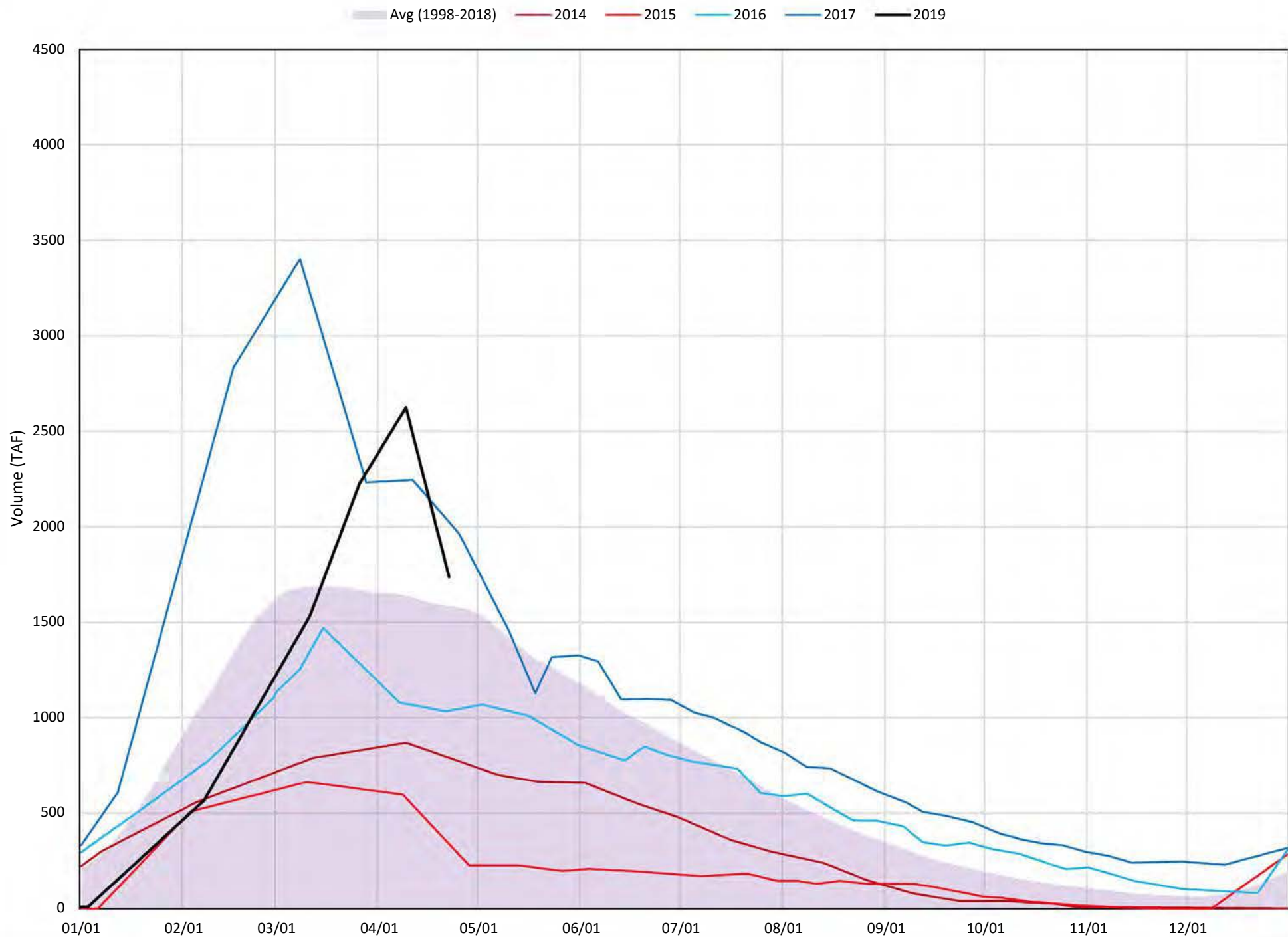
≤52°F - Shasta Cold Water Pool Volume



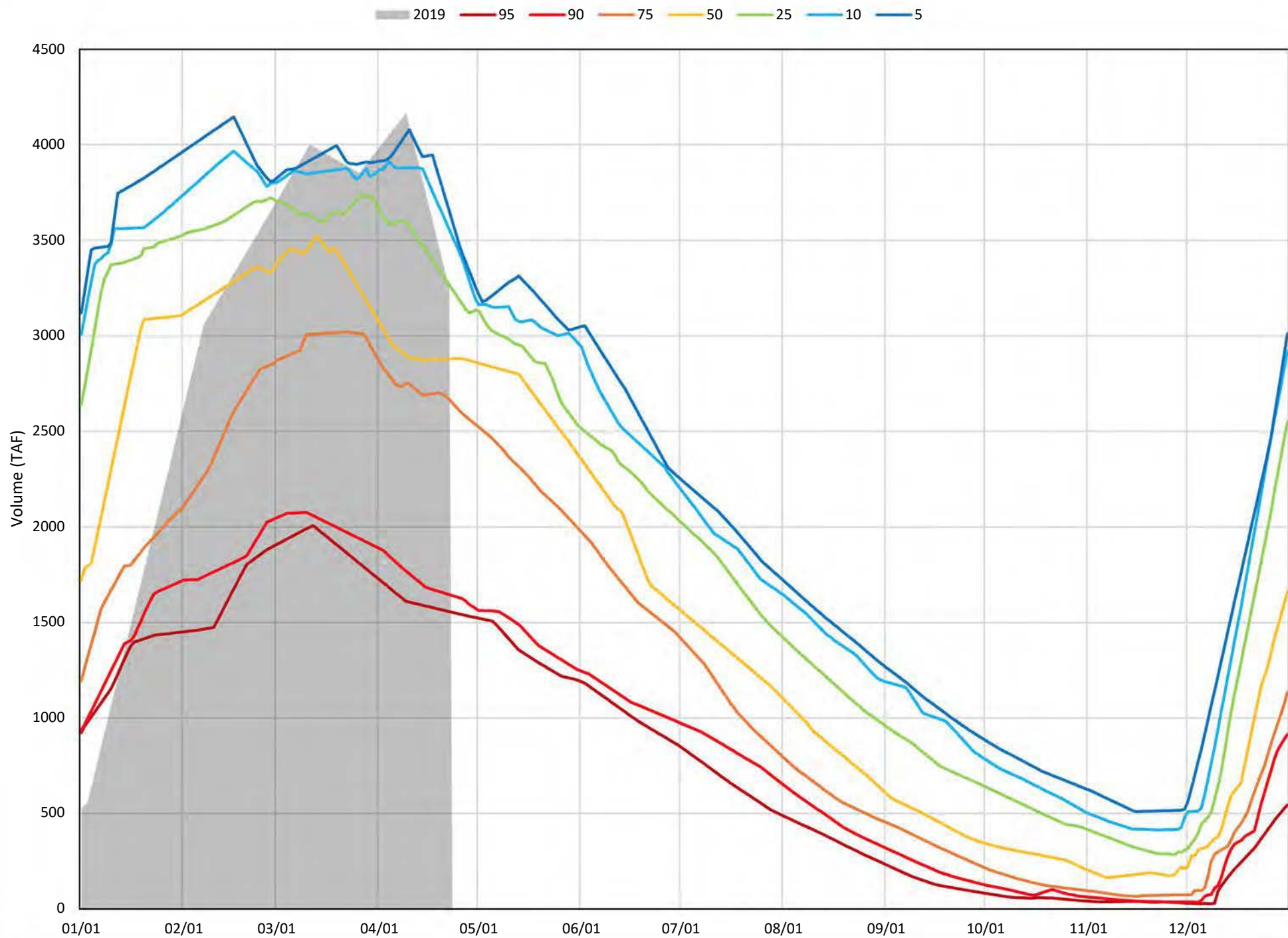
≤50°F - Shasta Cold Water Pool Volume



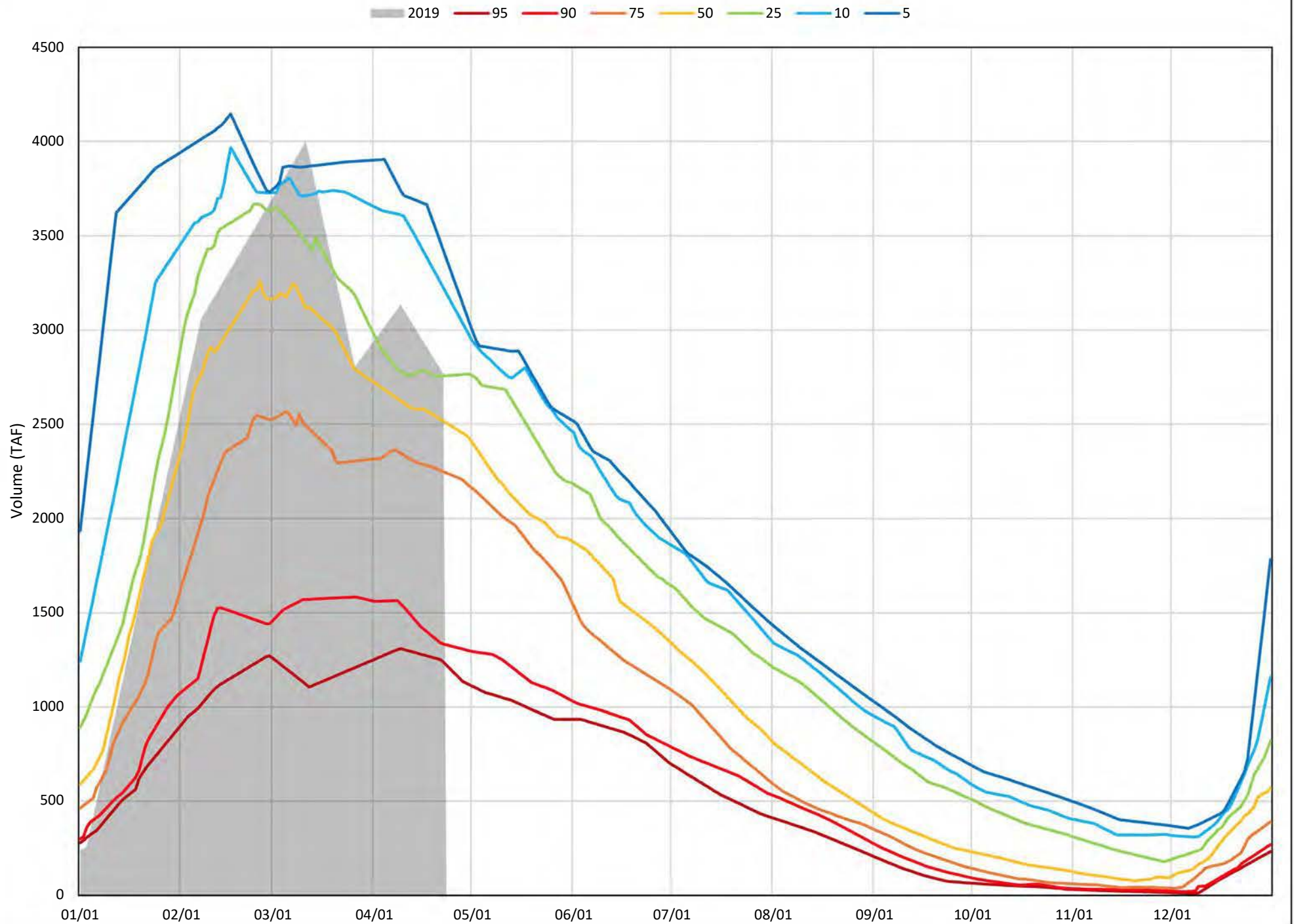
≤48°F - Shasta Cold Water Pool Volume



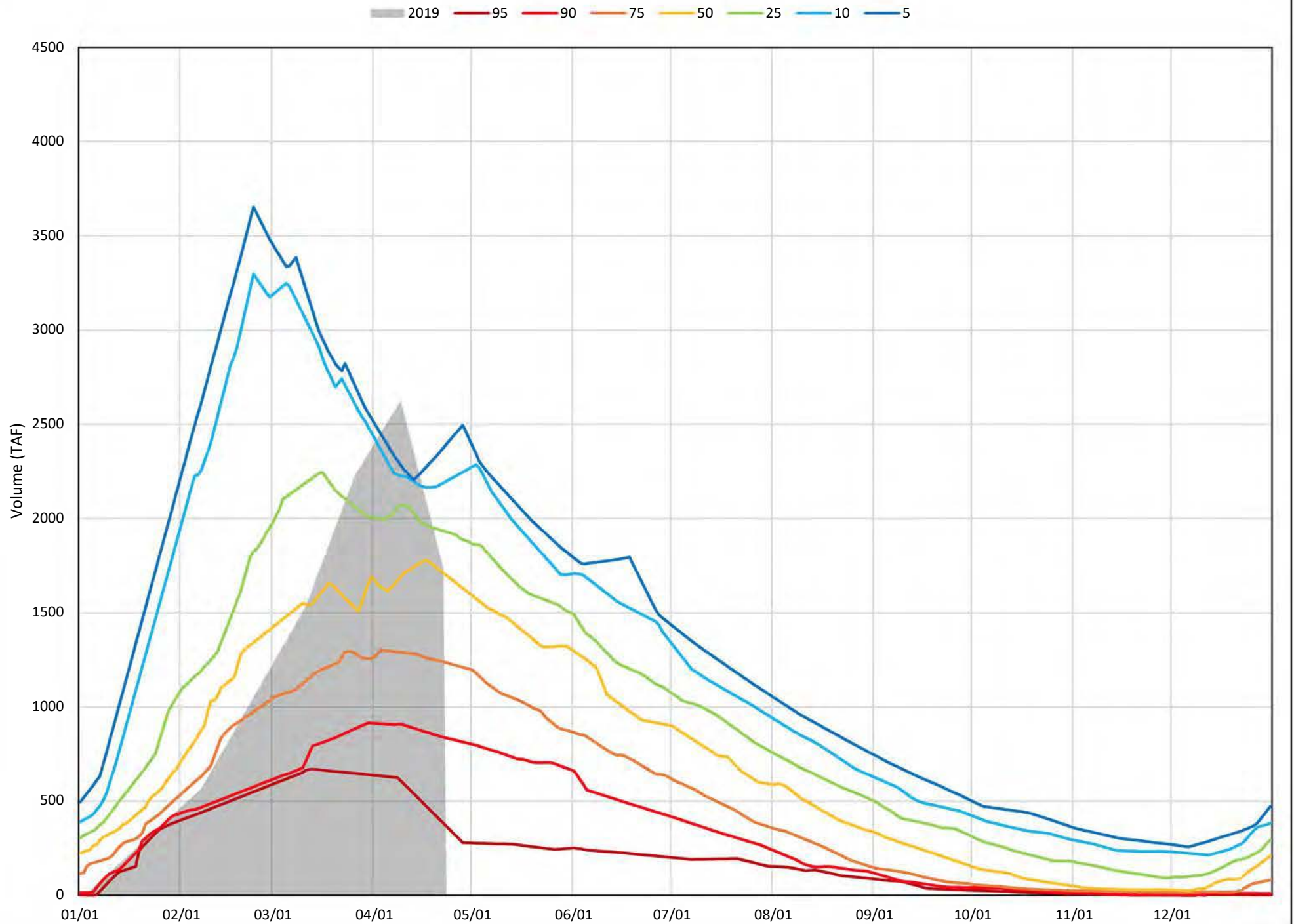
≤52°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)



≤50°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)



≤48°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)



April 24, 2019

Upper Sacramento River – April 2019 Preliminary Temperature Analysis

Summary of Temperature Results by Month (Monthly Average Temperature °F)

Location (°F DAT)	APR	MAY	JUN	JUL	AUG	SEP*	OCT*
April 90%-Exceedance Outlook – 25% L3MTO Meteorology							
Keswick Dam KWK	53.1	52.7	52.4	52.8	53.0	See Figures 1 and 5	See Figures 1 and 5
Sac. R. abv Clear Creek CCR	53.4	53.4	53.1	53.3	53.4	See Figures 1 and 6	See Figures 1 and 6
Balls Ferry BSF	55.6	57.2	55.9	55.5	55.1	See Figures 1 and 7	See Figures 1 and 7
April 90%-Exceedance Outlook – 50% L3MTO Meteorology							
Keswick Dam KWK	52.8	52.5	52.7	52.9	52.8	See Figures 2 and 5	See Figures 2 and 5
Sac. R. abv Clear Creek CCR	52.7	53.1	53.1	53.5	53.2	See Figures 2 and 6	See Figures 2 and 6
Balls Ferry BSF	53.7	56.3	55.3	55.6	54.8	See Figures 2 and 7	See Figures 2 and 7

Location (°F DAT)	APR	MAY	JUN	JUL	AUG	SEP*	OCT*
April 50%-Exceedance Outlook – 25% L3MTO Meteorology							
Keswick Dam KWK	53.4	52.7	52.4	52.9	52.9	See Figures 3 and 5	See Figures 3 and 5
Sac. R. abv Clear Creek CCR	53.9	53.4	53.0	53.5	53.3	See Figures 3 and 6	See Figures 3 and 6
Balls Ferry BSF	56.3	57.2	56.0	55.7	54.8	See Figures 3 and 7	See Figures 3 and 7
April 50%-Exceedance Outlook – 50% L3MTO Meteorology							
Keswick Dam KWK	53.1	52.8	52.4	52.9	53.0	See Figures 4 and 5	See Figures 4 and 5
Sac. R. abv Clear Creek CCR	53.0	53.4	52.9	53.5	53.3	See Figures 4 and 6	See Figures 4 and 6
Balls Ferry BSF	54.0	56.6	55.2	55.7	54.8	See Figures 4 and 7	See Figures 4 and 7

Model Run	End of September Cold Water Pool <56°F (TAF)	First Side Gate	Full Side Gates
90% Hydro, 25% Met	716	9/22	11/1
90% Hydro, 50% Met	903	10/3	11/28
50% Hydro, 25% Met	707	9/20	10/31
50% Hydro, 50% Met	944	10/5	11/27

Model Run Date April 24, 2019

* The HEC5Q model output is displayed above for the months April through August. Based on past analysis, the temperature model does not perform well in late September and October. One factor is that the modeled release temperatures are cooler than has historically been achieved when all release is through the side gates (lowest gates), especially when there's a large temperature gradient between the pressure relief gates (PRG) and the side gates.

For the months of September and October, ranges in possible outcomes are illustrated with the Fall Temperature Index (graphics above Figures 5-7). This relationship is an end of September Lake Shasta Volume less than 56°F and likely downstream temperature performance for the early fall months. Estimated temperatures for September and October may fall into a range indicated within the Fall Temperature Index (graphical chart), illustrating historical performance. However, this range should be viewed as an element of uncertainty based on past performance, not a simulation or projection of temperature management operations or results.

Temperature Analysis Results:

Modeling runs explore Sacramento River compliance performance above Clear Creek confluence and Balls Ferry locations by varying hydrology and meteorology. The temperature results for the Sacramento River between Keswick Dam and Balls Ferry are shown in Figures 1 through 4. The relationship between end-of-September lake volume below 56°F and a downstream Sacramento River compliance location through fall is based on the Figures 5-7.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on April 23, April 10, and April 9, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The April 2019 temperature profile does not yet exhibit conditions for ideal model computations (still nearly isothermal conditions). The model performs well after the reservoir stratifies, typically in late spring (i.e. end of April). The concern this year is assuming over or under estimations with variable hydrologic and meteorological conditions and not capturing the stratification with sufficient

detail to project into the future with confidence.

2. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge are not available beyond 5 days. Creek flows developed from the historical record that most closely reflects current conditions were used for all model runs. The resulting creek flows cause significant additional warming in the upper Sacramento River during spring.
3. Operation is based on the April 2019 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90%- and 50%-exceedances, with minor modifications to accommodate for flood management. Trinity Lake inflows are updated with the CNRFC 90% runoff exceedance for the 90% and DWR Bulletin 120 for the 50% runoff exceedance studies.
4. Although mean daily flows and releases are temperature model inputs, they are based on the mean monthly values from the operation outlooks. Mean daily flow patterns are user defined and are generalized representations. It is important to note that these outlooks do not suggest a certain actual future outcome, but rather the statistical likelihood of an event occurring, including, but not limited to, projected storage and releases. Thus, the outlooks do not provide exact end of month storages or flow rates but general projections that will likely fall within the range of uncertainty based on the different hydrologic runoff conditions between the 90% and 50% runoff exceedance hydrology.
5. Cottonwood Creek flows, Keswick to Bend Bridge local flows, and ACID diversions are mean daily synthesized flows based on the available historical record for a 1922-2002 study period. Side-flows were adjusted to a 25% historical exceedance for both the 90% and 50% runoff exceedance studies.
6. Meteorological inputs represent historical (1985 – 2017) monthly mean equilibrium temperature exceedance at 25% and 50% patterned after like months on a 6-hour time-step (for months prior to April). Assumed inflows temperature remain static inputs and do not vary with the assumed meteorology. Tools to use local three-month-temperature outlooks, driven by the NOAA NWS Climate Prediction Center (CPC) are used beginning in April.
7. Meteorology, as well as the flow volume and pattern, significantly influences reservoir inflow temperatures and downstream tributary temperatures; and consequently, the development of the cold-water pool during winter and early spring, which is still uncertain prior to the end of April.
8. Modified model coefficients more closely represent actual Keswick Dam temperatures. As a result, temperature predictions downstream of Keswick Dam are likely to be warmer than actual.
9. The model is specifically being applied to generate the most accurate results at the Sacramento River above Clear Creek confluence location.

Sacramento River Modeled Temperature 2019 April 90%-Exceedance Water Outlook - 25% L3MTO Meteorology

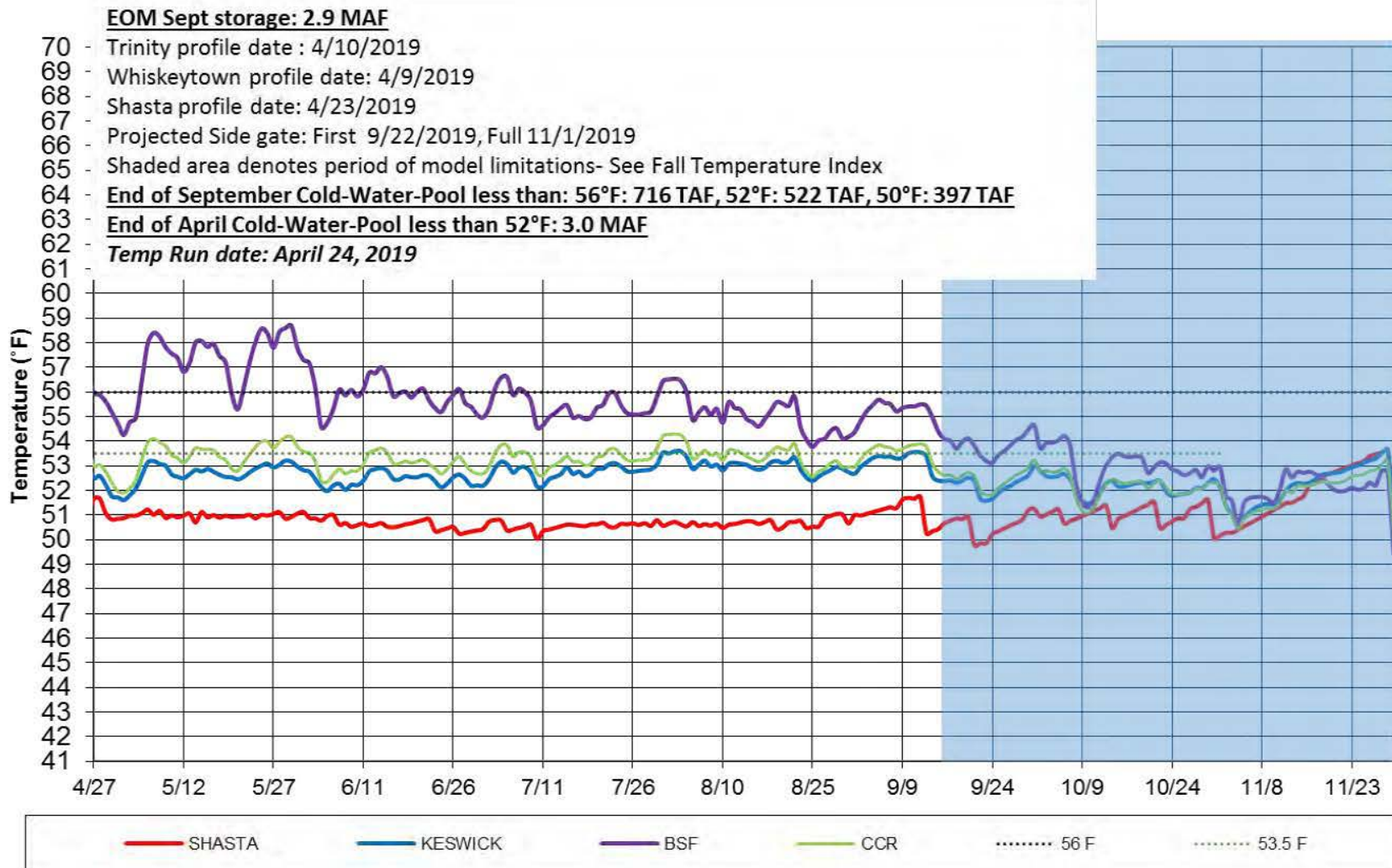


Figure 1. April 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology.

Sacramento River Modeled Temperature 2019 April 90%-Exceedance Water Outlook - 50% L3MTO Meteorology

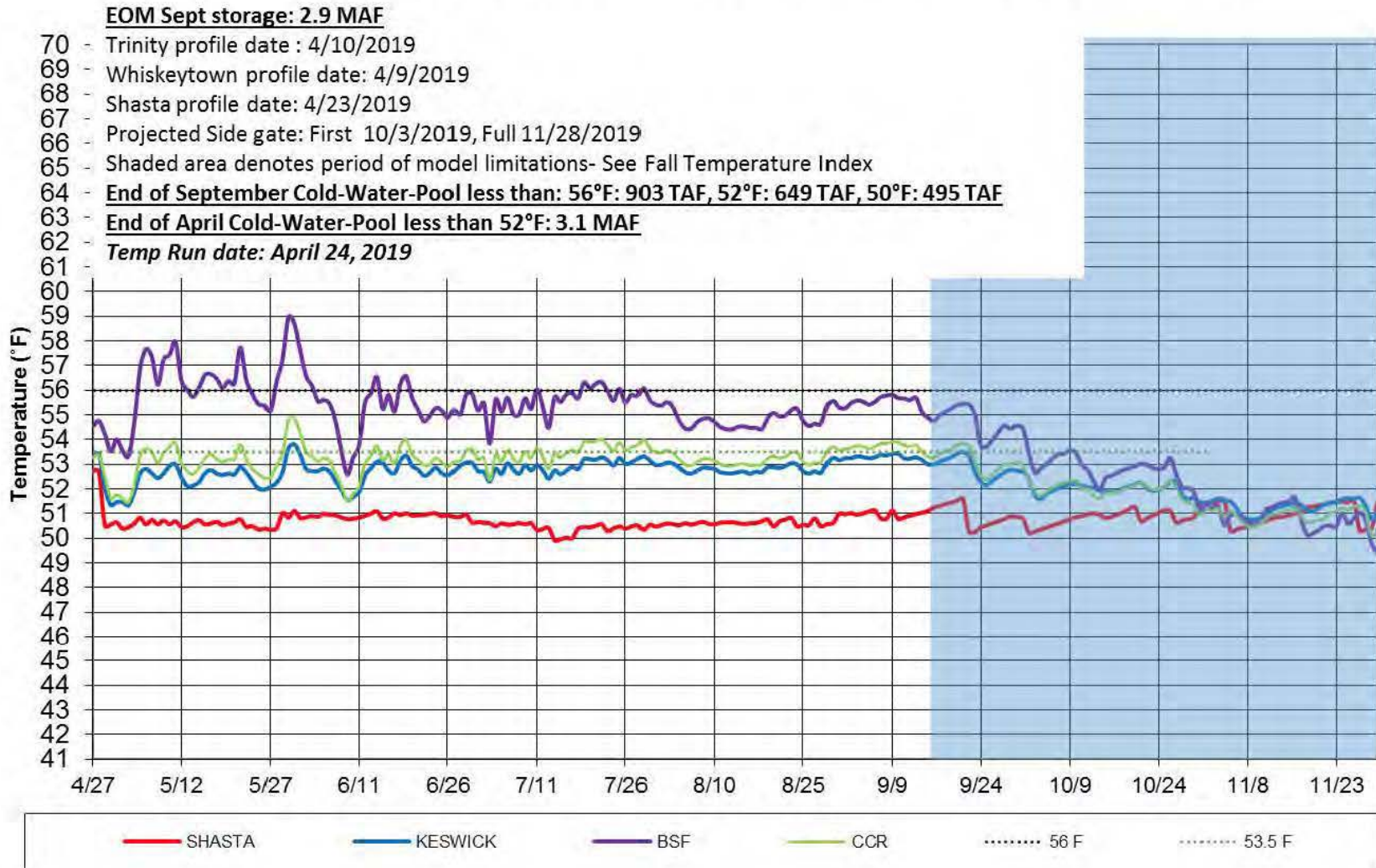


Figure 2. April 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 50% L3MTO meteorology.

Sacramento River Modeled Temperature 2019 April 50%-Exceedance Water Outlook - 25% L3MTO Meteorology

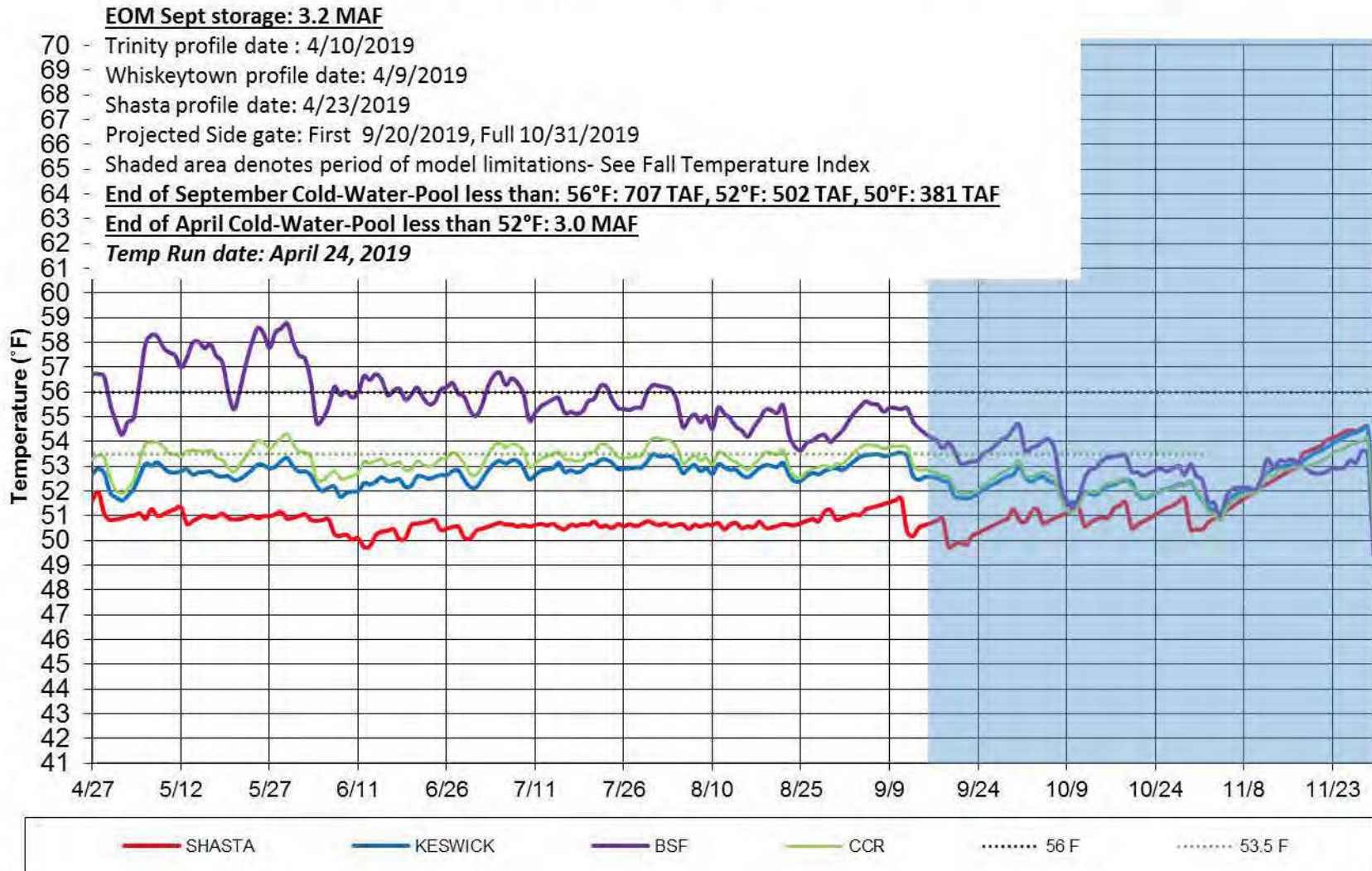


Figure 3. April 2019 simulated Sacramento River temperatures 50% runoff exceedance hydrology and 30% L3MTO meteorology.

Sacramento River Modeled Temperature 2019 April 50%-Exceedance Water Outlook - 50% L3MTO Meteorology

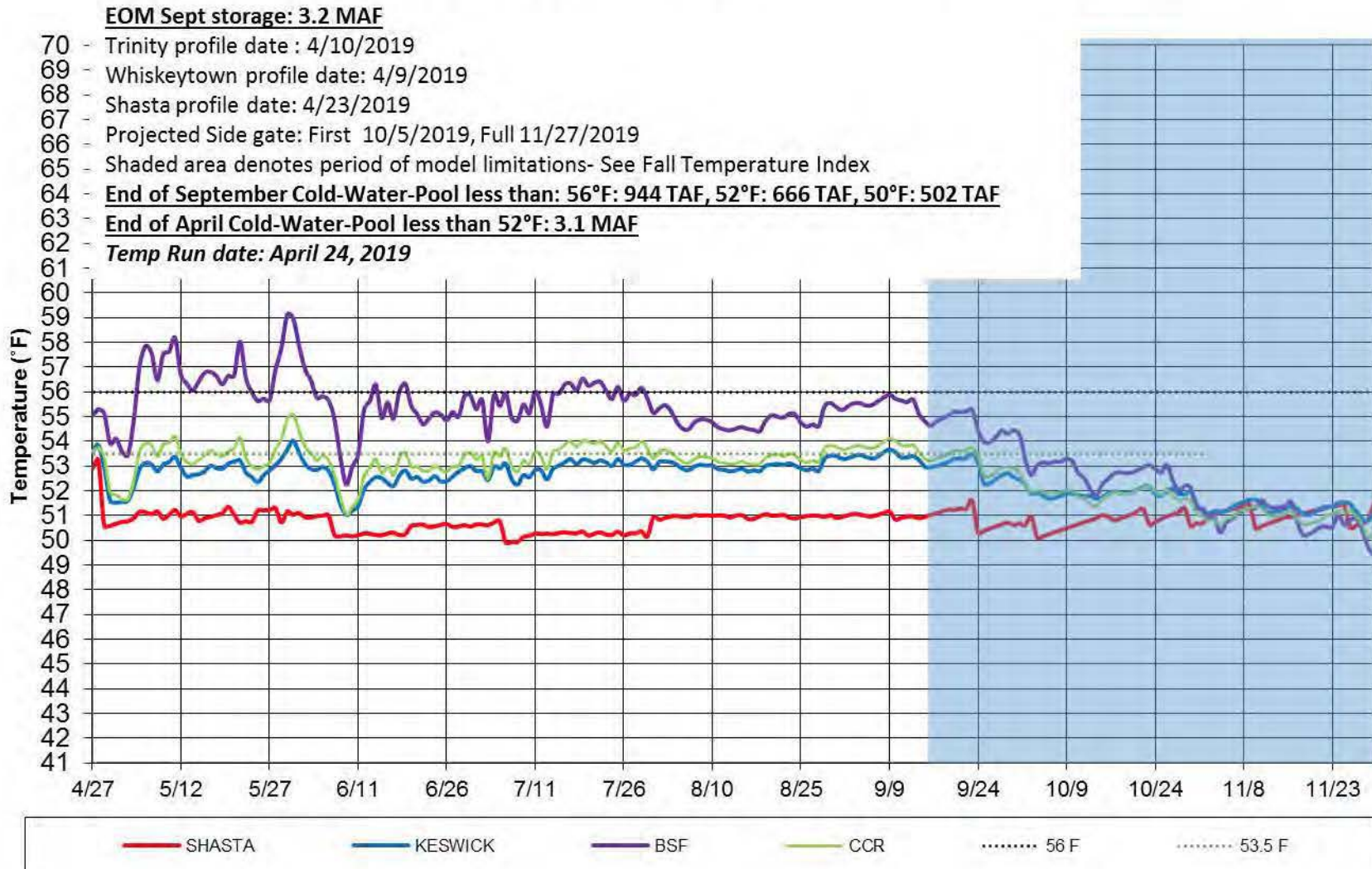


Figure 4. April 2019 simulated Sacramento River temperatures 50% runoff exceedance hydrology and 50% L3MTO meteorology

Figure 5-7 Model Performance and Fall Temperature Index:

1. Based on past analyses, the temperature model does not perform well in late September and October. One factor is that the modeled release temperatures are cooler than has historically been achieved when all release is through the side gates (lowest gates), especially when there's a large temperature gradient between the pressure relief gates (PRG) and the side gates.
2. Based on historical records, the end-of-September Lake Shasta volume below 56°F is a good indicator of fall water temperature in the river reach to Balls Ferry.
3. Based on these records and estimates, the charts below illustrates a range of uncertainty in the expected river temperatures based on the end-of-September lake volume less than 56°F.

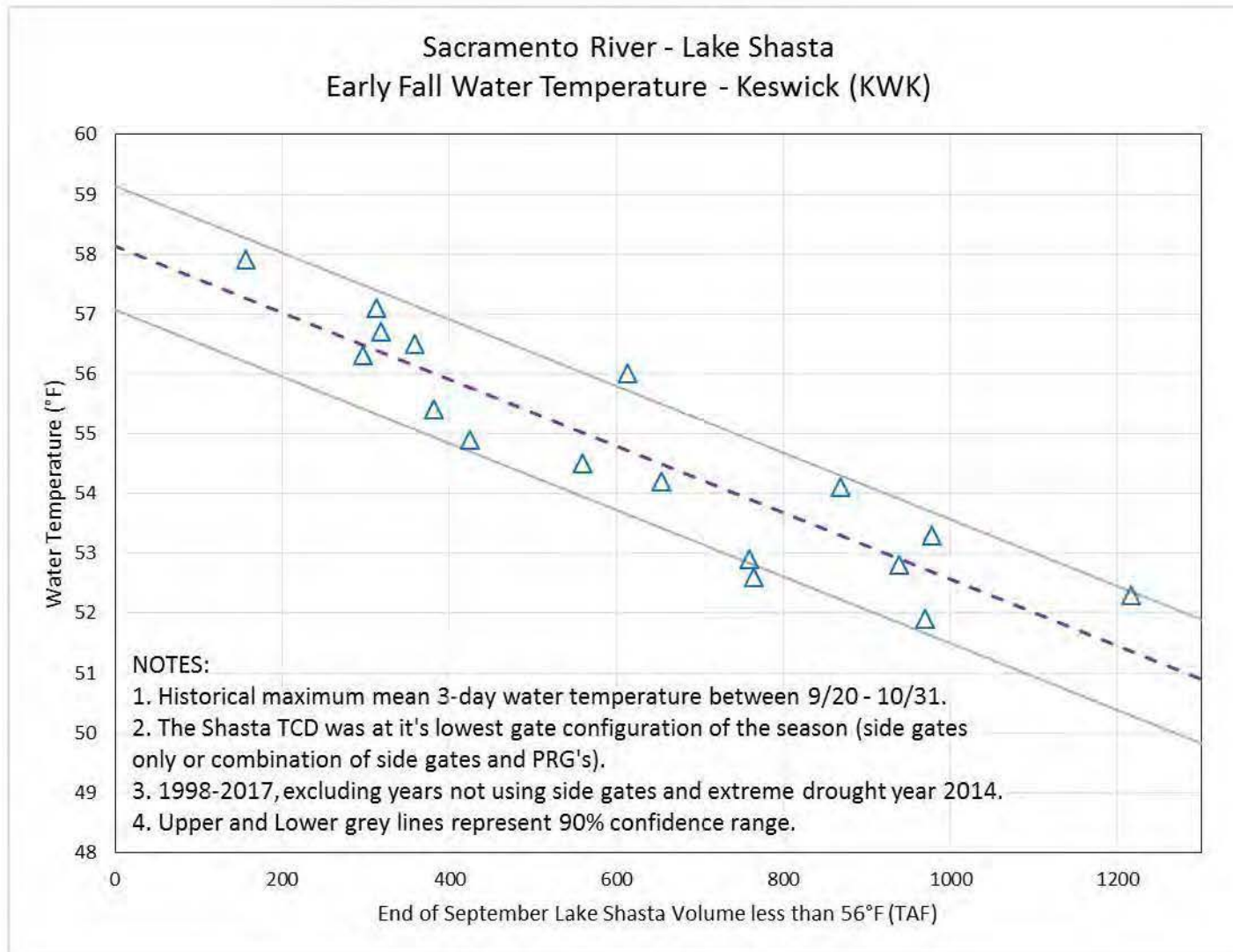


Figure 5. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

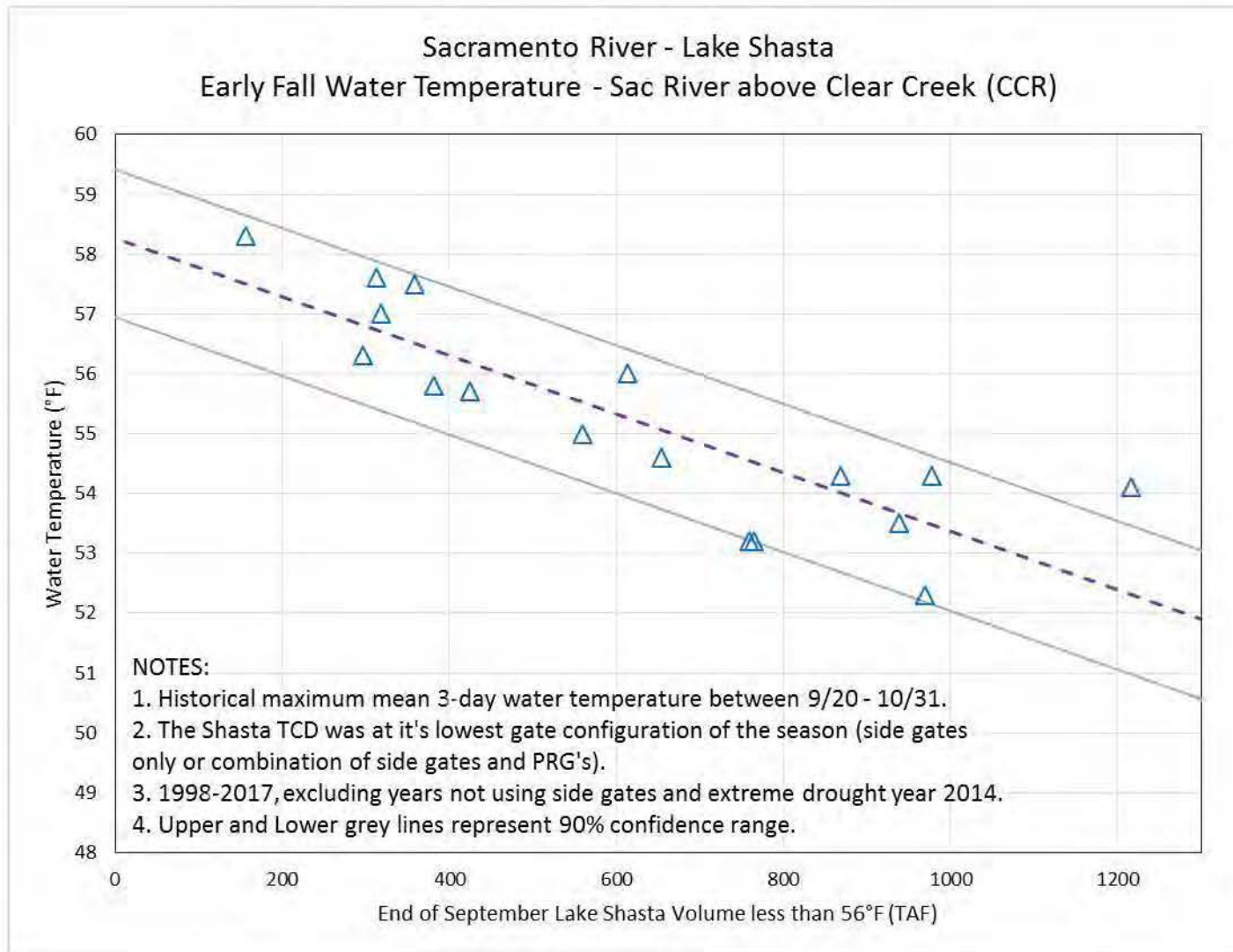


Figure 6. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

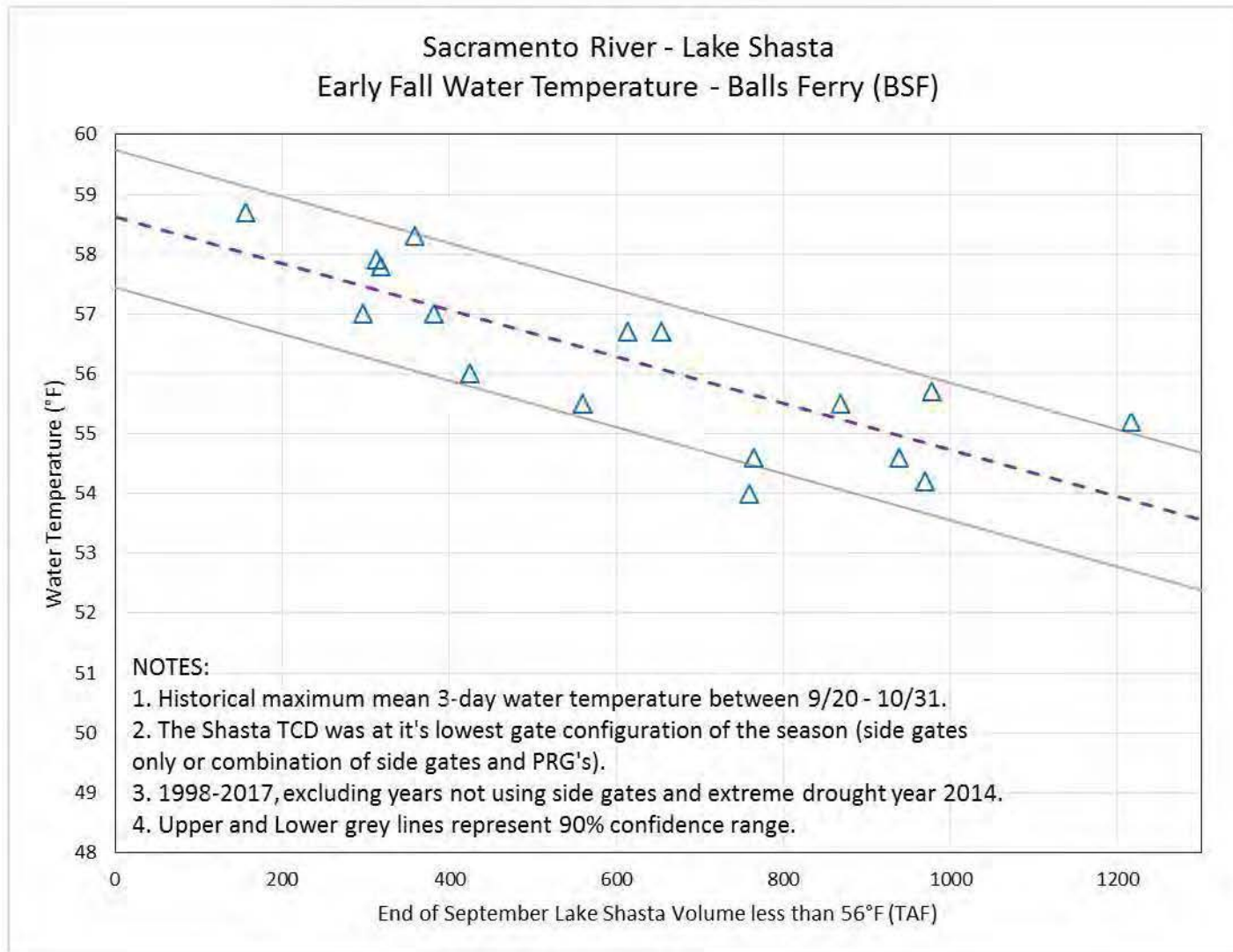
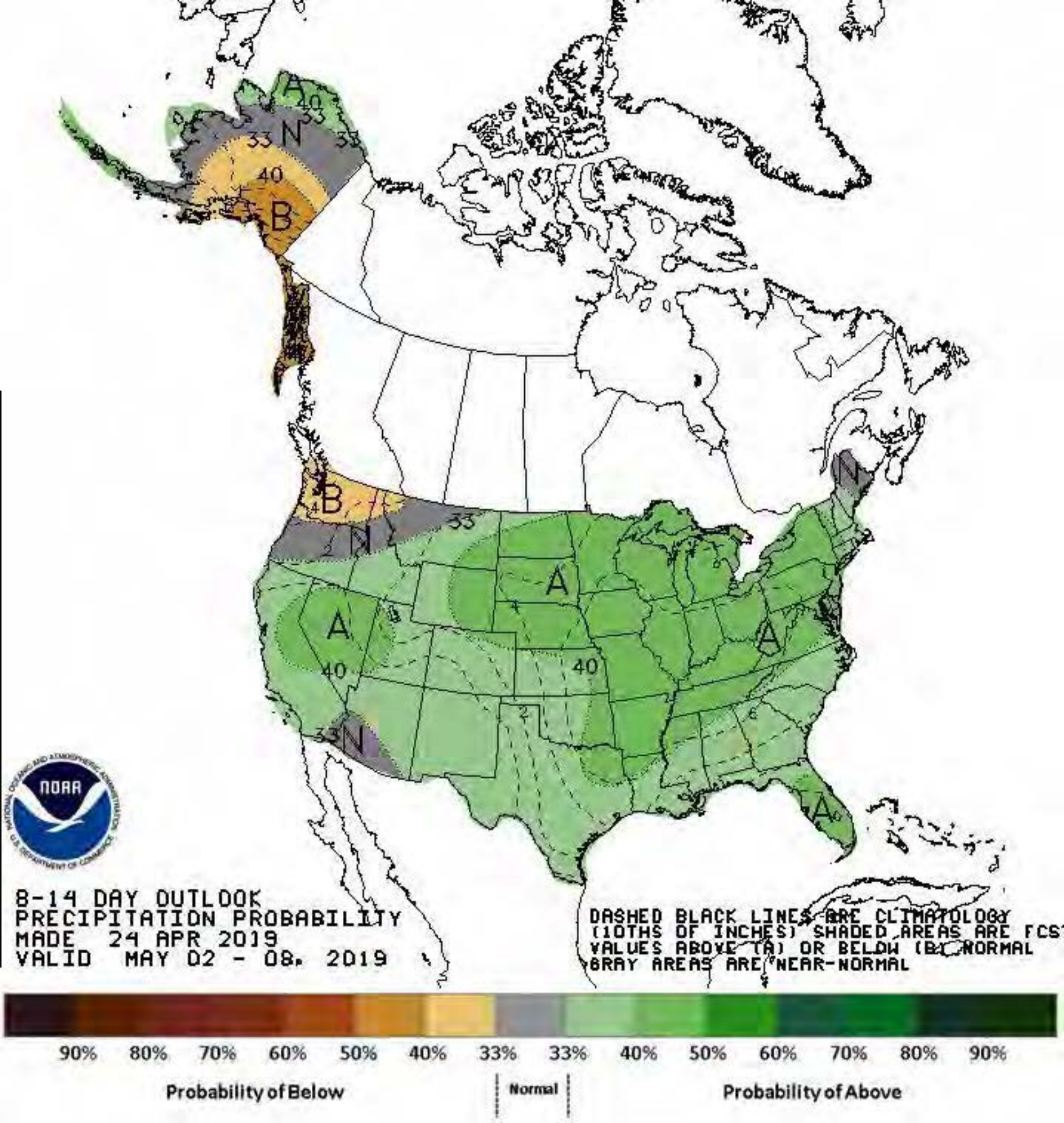
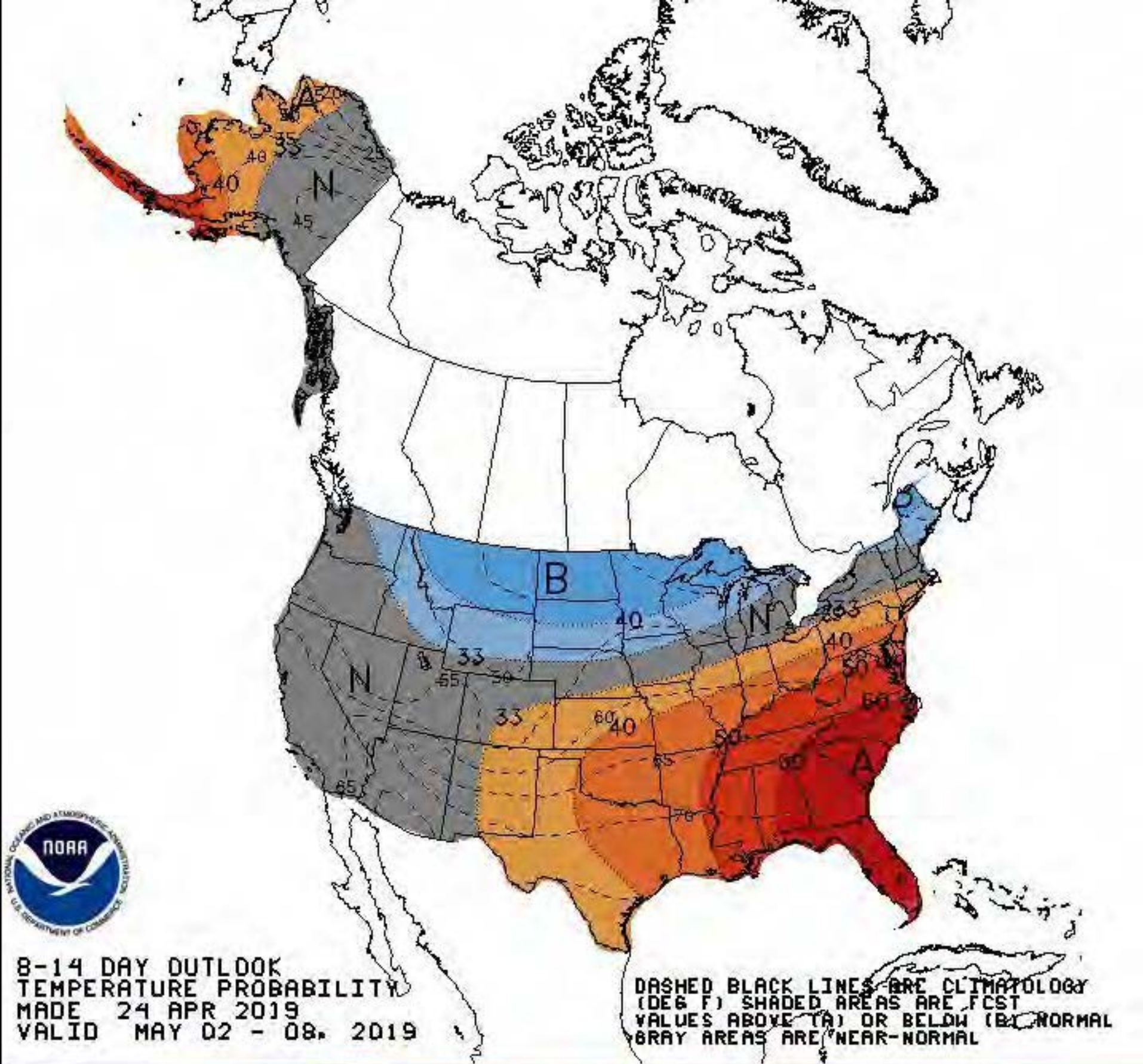


Figure 7. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.





90% 80% 70% 60% 50% 40% 33% 33% 40% 50% 60% 70% 80% 90%

Probability of Below

Normal

Probability of Above

Northern CVP Water Temperature Report

April - 2019

Page	Description
1	- Mean Daily Water Temperature, Release Flow Rates and Air Temperatures with Monthly Averages
2	- Redding 10-Day Forecasted Air Temperatures
3	- Sacramento River Mean Daily Water Temperature, Air Temperature and 10-Day Forecasted Air Temperature Plot - Water Temperature Measuring Station Details - Temperature Control Point Details
4	- Daily Maximum and 7DADM
5	- Shasta Lake Isothermobaths Plot
6	- Trinity Lake Isothermobaths Plot
7	- Whiskeytown Lake Isothermobaths Plot
x	- TCD Configuration (External Link)



All Data in this Report is Preliminary and Subject to Change

D A T E	Mean Daily Water Temperatures (°F)														Mean Daily Release (CFS)			Mean Daily Air Temperatures (°F)						
	TCD ¹	SHD		SPP ¹	KWK	SAC	CCR	BSF ²	JLF	BND	RDB	IGO	LWS	----- ³	Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS			
Mar	49.2			46.8	48.2	48.6	48.6	49.3	49.7	50.4	50.2	48.6	46.3	-	13154	2002	24947	52.9	51.3	52.6	-			
04/01	50.8	#	-		47.3	49.3	49.6	49.8	51.1	52.1	52.6	52.9	50.9	50.2	-	13113	1367	14931	60.0	58.0	59.8	-		
04/02	50.0	#	-		47.8	49.0	49.3	49.5	50.9	51.7	52.1	52.3	50.6	50.2	-	16762	2872	14957	56.5	55.0	56.3	-		
04/03	49.2	#	-		47.8	48.9	49.3	49.3	51.1	52.1	52.4	52.5	50.8	50.5	-	16408	1472	17635	58.0	56.3	57.0	-		
04/04	49.1	#	-		47.7	48.7	48.9	48.9	50.3	51.2	51.6	52.1	50.6	50.3	-	18860	1613	26364	58.5	57.5	57.6	-		
04/05	48.5	#	-		48.0	48.1	48.5	48.3	49.5	50.3	50.7	51.2	?	50.3	50.5	-	18792	2735	29893	57.5	56.5	55.8	-	
04/06	48.5	#	-		48.1	47.9	48.3	48.1	49.4	50.1	50.5	50.7	?	50.8	50.3	-	18888	2880	30220	58.5	58.0	58.2	-	
04/07	48.8	#	-		48.0	48.1	48.3	48.2	49.5	50.4	50.7	51.5	51.8	51.2	-	18826	1553	29903	63.0	63.2	63.6	-		
04/08	49.2	#	-		48.2	48.4	48.8	48.6	50.2	50.8	51.0	51.8	52.6	51.2	-	19124	1134	30762	60.0	63.0	64.6	-		
04/09	49.7	#	-		48.9	48.6	48.8	48.8	51.0	51.8	52.2	52.4	51.6	50.8	-	18927	1794	35669	59.5	56.5	59.9	-		
04/10	50.3	#	-		48.5	49.0	49.1	49.1	50.0	50.6	50.9	51.2	50.9	51.3	-	18854	1166	39956	58.0	57.6	59.3	-		
04/11	50.4	#	-		49.2	49.1	49.1	49.1	50.1	50.7	51.0	51.2	50.9	51.1	-	18990	781	40139	58.0	56.9	58.5	-		
04/12	50.6	#	-		49.2	49.2	49.3	49.3	50.2	50.8	51.1	51.4	51.4	51.9	-	18992	797	39664	60.5	59.3	60.6	-		
04/13	50.8	#	-		48.6	49.5	49.6	49.6	50.6	51.3	51.6	52.1	52.1	52.3	-	18870	425	39749	63.5	60.0	60.9	-		
04/14	50.5	#	-		49.1	49.3	49.3	49.4	50.4	51.3	51.6	52.0	?	51.9	52.3	-	19047	152	34602	62.0	60.6	60.0	-	
04/15	50.5	#	-		49.1	49.1	49.1	49.1	49.9	50.6	50.9	50.9	!	-	51.9	-	18982	227	29602	53.5	53.2	53.8	-	
04/16	50.7	#	-		48.5	49.6	49.8	49.8	50.7	51.3	51.5	51.6	51.3	49.7	-	18929	427	24956	58.0	55.4	56.8	-		
04/17	51.3	#	-		49.3	50.3	50.5	50.6	51.7	52.5	52.8	53.2	52.6	47.7	-	18512	233	21027	64.0	61.2	61.6	-		
04/18	51.6	#	-		49.1	51.1	51.4	51.5	53.0	54.0	54.3	54.6	54.3	46.6	-	17113	184	18127	67.0	65.1	65.5	-		
04/19	51.7	#	-		49.3	51.3	51.7	51.9	53.7	55.1	55.4	55.9	55.0	46.5	-	14251	302	15494	67.5	66.3	67.8	-		
04/20	51.7	#	-		49.8	51.2	51.4	51.7	53.5	55.0	55.6	56.2	53.8	46.8	-	13715	106	13105	62.5	63.6	63.3	-		
04/21	52.3	#	-		49.6	51.3	51.6	51.9	53.5	54.5	54.7	55.2	53.1	47.2	-	11197	77	11159	64.0	61.5	63.1	-		
04/22	52.3	#	-		49.4	52.1	52.6	52.9	54.6	55.7	56.1	56.4	53.9	47.4	-	9765	128	9561	70.0	67.5	70.0	-		
04/23	52.2	#	-		49.4	52.4	?	53.1	53.5	55.8	57.2	57.6	58.2	55.5	47.6	-	7881	147	8202	↑	78.0	73.2	76.3	-
04/24	51.9	#	-		49.5	52.4	53.3	54.0	56.8	58.7	59.1	59.8	56.3	47.8	-	7155	236	7019	76.5	72.0	74.8	-		
04/25																								
04/26																								
04/27																								
04/28																								
04/29																								
04/30																								
-																								
Apr	50.5		-		48.7	49.8	50.0	50.1	51.6	52.5	52.8	53.2	52.3	49.7	-	16331	950	24279	62.3	60.7	61.9	-		

Total CFS	391953	22808	582696
Total AF	777423	45239	1155754

Legend

?	= 1-9 hours of data missing (Average includes estimations)
!	= 10 or more hours of data missing (Average not calculated)
#	= Station out of service
↑	= Record high air temperature
↓	= Record low air temperature
	= Monthly Averages

Notes

- Temperatures are weighted averages based on individual penstock flow and temperature
Highlighted cells in the TCD column indicate a TCD change was made on that day
- Current control point (see page 3 for more details)
- Column not used this month

D A T E	Redding (RDD) Daily Air Temperatures (°F)																																			
	Actual			Forecasted																																
				Previous Day			Current Day			1 Day			2 Days			3 Days			4 Days			5 Days			6 Days			7 Days			8 Days			9 Days		
	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg
04/01	42	77	59.5	57	67	62.0	51	63	57.0	48	65	56.5	50	61	55.5	49	59	54.0	48	63	55.5	47	69	58.0	50	76	63.0	52	80	66.0	47	74	60.5	48	76	62.0
04/02	53	67	60.0	52	63	57.5	49	65	57.0	49	61	55.0	49	59	54.0	46	60	53.0	47	67	57.0	48	72	60.0	53	81	67.0	53	81	67.0	47	79	63.0	48	74	61.0
04/03	52	61	56.5	53	65	59.0	49	61	55.0	49	58	53.5	45	59	52.0	49	69	59.0	49	72	60.5	49	71	60.0	47	70	58.5	46	68	57.0	47	71	59.0	47	75	61.0
04/04	53	63	58.0	54	62	58.0	50	60	55.0	46	61	53.5	50	70	60.0	52	71	61.5	49	71	60.0	44	70	57.0	48	74	61.0	48	75	61.5	50	76	63.0	48	73	60.5
04/05	53	64	58.5	54	61	57.5	48	61	54.5	50	69	59.5	54	68	61.0	47	69	58.0	44	69	56.5	44	66	55.0	50	73	61.5	48	70	59.0	48	71	59.5	50	76	63.0
04/06	53	62	57.5	54	61	57.5	52	69	60.5	56	68	62.0	48	69	58.5	44	69	56.5	44	66	55.0	44	69	56.5	47	62	54.5	45	70	57.5	47	73	60.0	50	77	63.5
04/07	54	63	58.5	59	71	65.0	56	69	62.5	47	69	58.0	44	70	57.0	44	66	55.0	45	70	57.5	46	69	57.5	49	75	62.0	50	73	61.5	47	72	59.5	48	74	61.0
04/08	58	68	63.0	60	68	64.0	47	68	57.5	44	72	58.0	47	68	57.5	47	72	59.5	48	74	61.0	50	68	59.0	47	69	58.0	46	75	60.5	48	82	65.0	54	81	67.5
04/09	53	67	60.0	51	67	59.0	45	72	58.5	48	68	58.0	46	73	59.5	47	74	60.5	50	68	59.0	47	65	56.0	47	71	59.0	48	79	63.5	47	79	63.0	51	79	65.0
04/10	50	69	59.5	45	72	58.5	49	67	58.0	46	74	60.0	48	76	62.0	50	69	59.5	47	65	56.0	46	67	56.5	50	82	66.0	54	86	70.0	54	82	68.0	52	74	63.0
04/11	42	74	58.0	50	67	58.5	46	75	60.5	49	77	63.0	52	70	61.0	47	67	57.0	44	72	58.0	49	79	64.0	55	84	69.5	53	85	69.0	52	80	66.0	51	76	63.5
04/12	49	67	58.0	49	74	61.5	48	77	62.5	52	71	61.5	48	63	55.5	46	67	56.5	50	79	64.5	53	82	67.5	54	84	69.0	54	83	68.5	49	75	62.0	51	75	63.0
04/13	45	76	60.5	54	78	66.0	51	71	61.0	48	61	54.5	46	70	58.0	48	82	65.0	54	86	70.0	57	82	69.5	56	85	70.5	55	87	71.0	54	85	69.5	54	79	66.5
04/14	52	75	63.5	57	70	63.5	46	60	53.0	45	71	58.0	47	81	64.0	54	87	70.5	57	84	70.5	57	76	66.5	53	78	65.5	49	80	64.5	51	78	64.5	50	76	63.0
04/15	56	68	62.0	53	59	56.0	44	70	57.0	48	82	65.0	56	87	71.5	58	85	71.5	58	78	68.0	53	76	64.5	53	84	68.5	55	86	70.5	51	82	66.5	52	81	66.5
04/16	48	59	53.5	47	70	58.5	49	82	65.5	56	86	71.0	58	82	70.0	57	77	67.0	51	78	64.5	52	80	66.0	52	83	67.5	55	86	70.5	54	85	69.5	55	82	68.5
04/17	47	69	58.0	46	82	64.0	55	86	70.5	57	83	70.0	58	75	66.5	53	80	66.5	54	81	67.5	56	82	69.0	61	91	76.0	57	90	73.5	54	86	70.0	54	82	68.0
04/18	44	84	64.0	51	87	69.0	56	84	70.0	59	73	66.0	53	81	67.0	54	85	69.5	58	87	72.5	59	85	72.0	59	87	73.0	56	86	71.0	54	81	67.5	53	81	67.0
04/19	50	84	67.0	54	83	68.5	56	70	63.0	50	80	65.0	53	85	69.0	59	89	74.0	60	86	73.0	60	82	71.0	57	82	69.5	53	83	68.0	53	82	67.5	53	84	68.5
04/20	53	82	67.5	57	71	64.0	49	80	64.5	53	86	69.5	59	90	74.5	61	90	75.5	61	86	73.5	60	80	70.0	56	84	70.0	53	85	69.0	54	84	69.0	55	84	69.5
04/21	54	71	62.5	51	80	65.5	52	86	69.0	59	91	75.0	60	91	75.5	61	87	74.0	60	80	70.0	56	80	68.0	53	82	67.5	51	75	63.0	48	77	62.5	50	79	64.5
04/22	49	79	64.0	54	87	70.5	59	92	75.5	61	92	76.5	61	89	75.0	59	84	71.5	57	84	70.5	56	78	67.0	53	76	64.5	48	74	61.0	49	74	61.5	49	78	63.5
04/23	52	88	70.0	65	91	78.0	62	93	77.5	62	89	75.5	59	87	73.0	58	83	70.5	57	79	68.0	55	78	66.5	55	83	69.0	52	84	68.0	53	85	69.0	52	82	67.0
04/24	63	93	78.0	62	93	77.5	61	90	75.5	59	88	73.5	58	88	73.0	58	82	70.0	56	81	68.5	54	77	65.5	53	80	66.5	50	80	65.0	53	84	68.5	55	83	69.0
04/25	62	91	76.5	61	90	75.5	59	87	73.0	58	87	72.5	57	83	70.0	56	82	69.0	54	76	65.0	51	78	64.5	49	82	65.5	51	83	67.0	53	82	67.5	55	84	69.5
04/26																																				
04/27																																				
04/28																																				
04/29																																				
04/30																																				
-																																				

[Web Links](#)

[Legend](#)

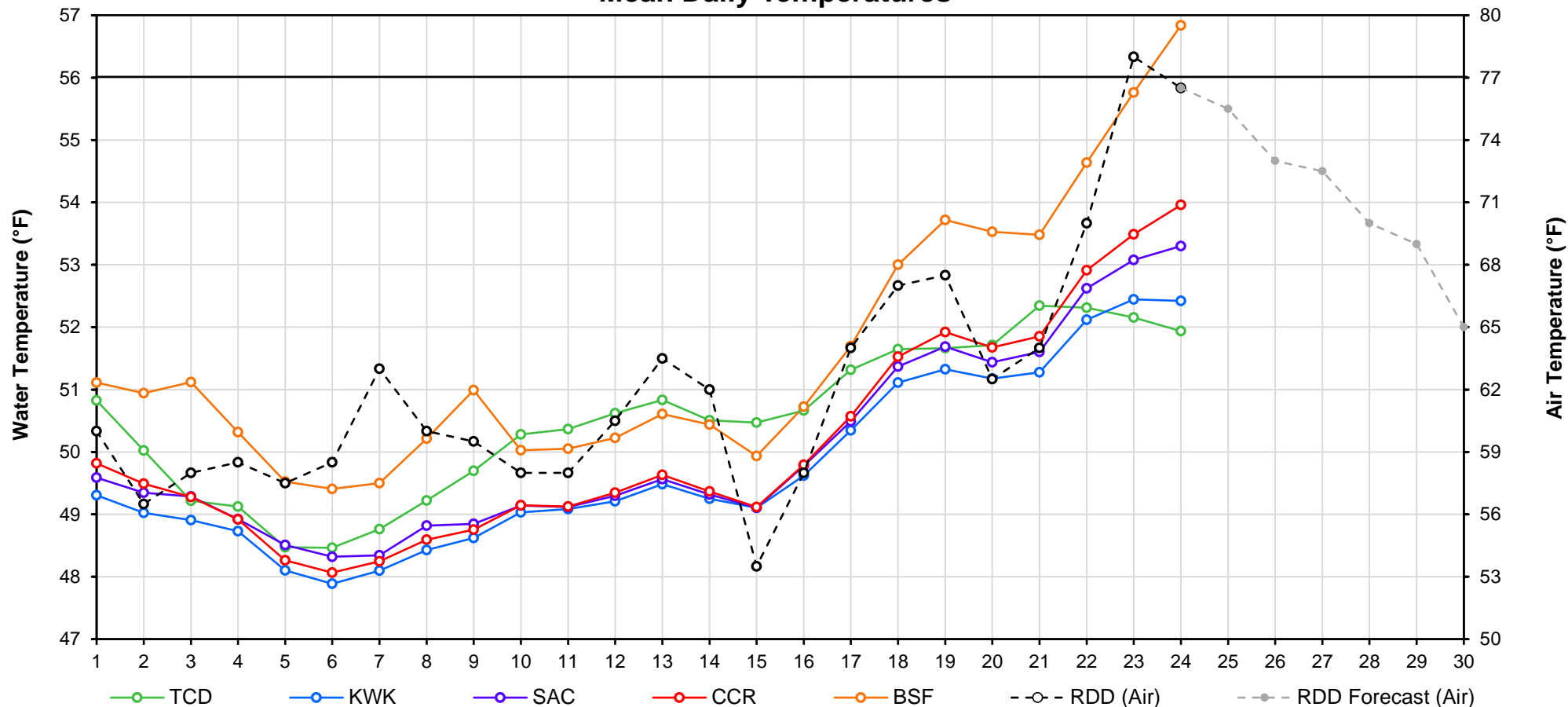
[10-Day Min/Max Forecast](#)

[Previous Days Min/Max Actuals](#)

NR = Forecasted temperatures not recorded

100 = Previous day actual temperatures in red and bolded indicate a record temperature for that date

Mean Daily Temperatures



Station Details			
Code	Body of Water	Location ¹	CDEC Link
TCD	N/A	Shasta Power Plant	N/A
SHD	Sacramento River	0.3 miles downstream of Shasta Power Plant	Click Here
SPP	N/A	Spring Creek Power Plant	N/A
KWK	Sacramento River	0.8 miles downstream of Keswick Dam	Click Here
SAC	Sacramento River	4.8 miles downstream of Keswick Dam	Click Here
CCR	Sacramento River	9.7 miles downstream of Keswick Dam	Click Here
BSF	Sacramento River	25 miles downstream of Keswick Dam	Click Here
JLF	Sacramento River	34 miles downstream of Keswick Dam	Click Here
BND	Sacramento River	41 miles downstream of Keswick Dam	Click Here
RDB	Sacramento River	58 miles downstream of Keswick Dam	Click Here
IGO	Clear Creek	7.3 miles downstream of Whiskeytown Dam	Click Here
LWS	Trinity River	1.1 miles downstream of Lewiston Dam	Click Here
DGC ²	Trinity River	19 miles downstream of Lewiston Dam	Click Here
NFH ³	Trinity River	38 miles downstream of Lewiston Dam	Click Here

Temperature Control Point		
Point	Temp. (°F)	Begin Date
BSF	56.0	05/25/2018

Notes

¹ Distances are approximate

² DGC is only reported in September

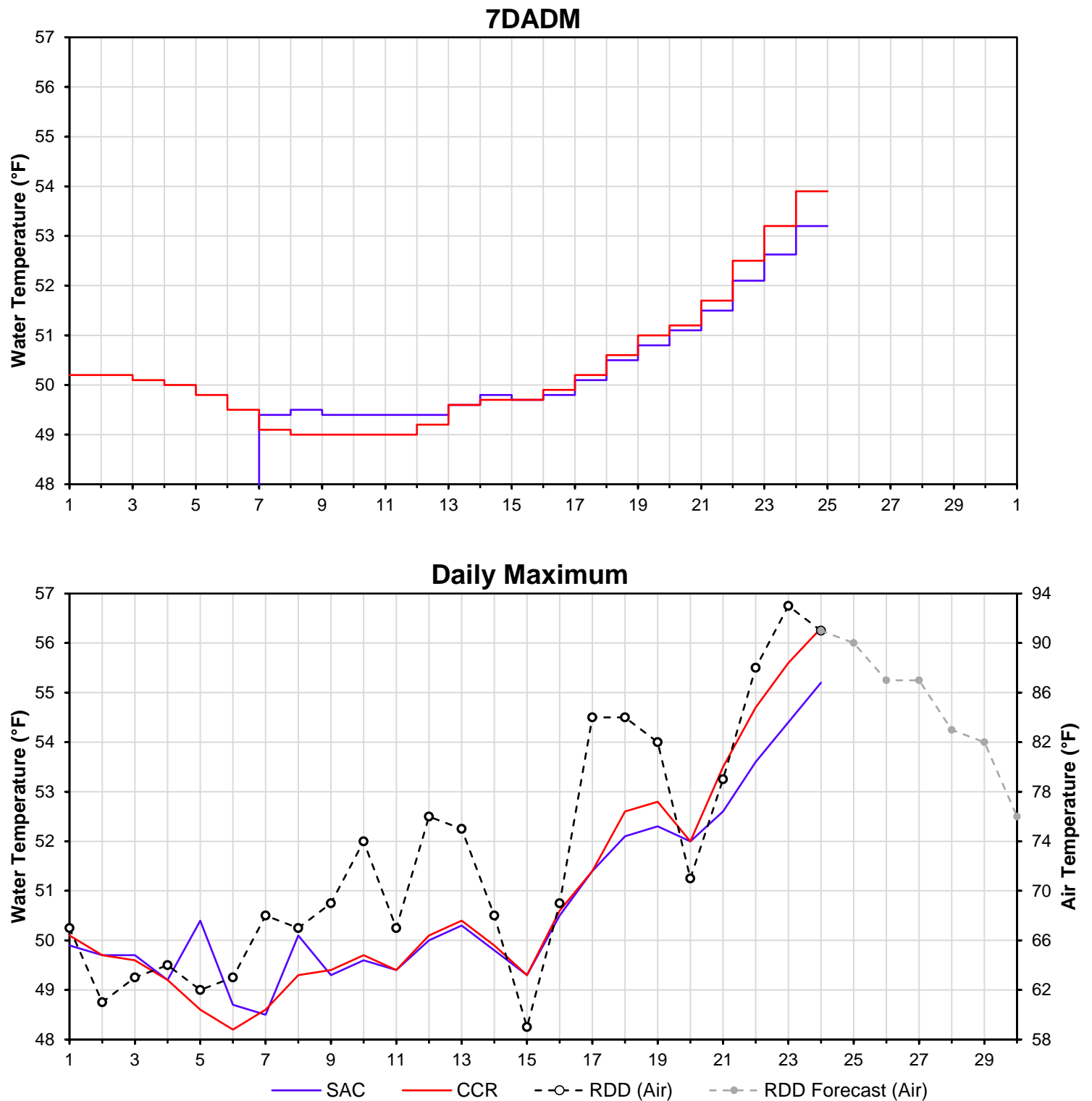
³ NFH is only reported in October, November and December

D A T E	Daily Max		7DADM ¹		DAT ²
	SAC	CCR	SAC	CCR	BSF
04/01	49.9	50.1	-	50.2	51.1
04/02	49.7	49.7	-	50.2	50.9
04/03	49.7	49.6	-	50.1	51.1
04/04	49.2	49.2	-	50.0	50.3
04/05	50.4	48.6	-	49.8	49.5
04/06	48.7	48.2	-	49.5	49.4
04/07	48.5	48.6	49.4	49.1	49.5
04/08	50.1	49.3	49.5	49.0	50.2
04/09	49.3	49.4	49.4	49.0	51.0
04/10	49.6	49.7	49.4	49.0	50.0
04/11	49.4	49.4	49.4	49.0	50.1
04/12	50.0	50.1	49.4	49.2	50.2
04/13	50.3	50.4	49.6	49.6	50.6
04/14	49.8	49.9	49.8	49.7	50.4
04/15	49.3	49.3	49.7	49.7	49.9
04/16	50.5	50.6	49.8	49.9	50.7
04/17	51.4	51.4	50.1	50.2	51.7
04/18	52.1	52.6	50.5	50.6	53.0
04/19	52.3	52.8	50.8	51.0	53.7
04/20	52.0	52.0	51.1	51.2	53.5
04/21	52.6	53.5	51.5	51.7	53.5
04/22	53.6	54.7	52.1	52.5	54.6
04/23	54.4	55.6	52.6	53.2	55.8
04/24	55.2	56.3	53.2	53.9	56.8
04/25					
04/26					
04/27					
04/28					
04/29					
04/30					
-					

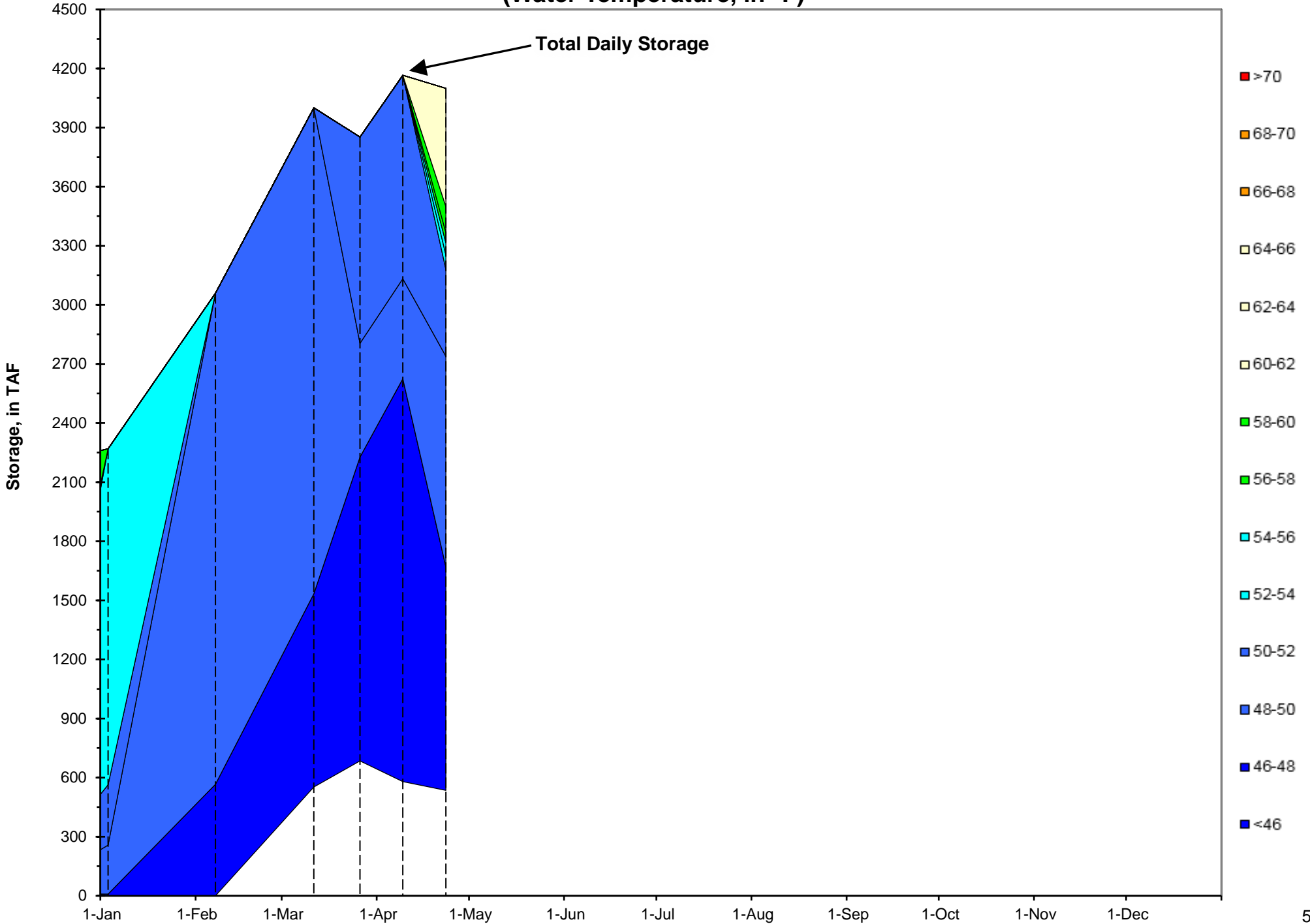
Notes

¹ 7DADM = 7-Day Average
Daily Maximum

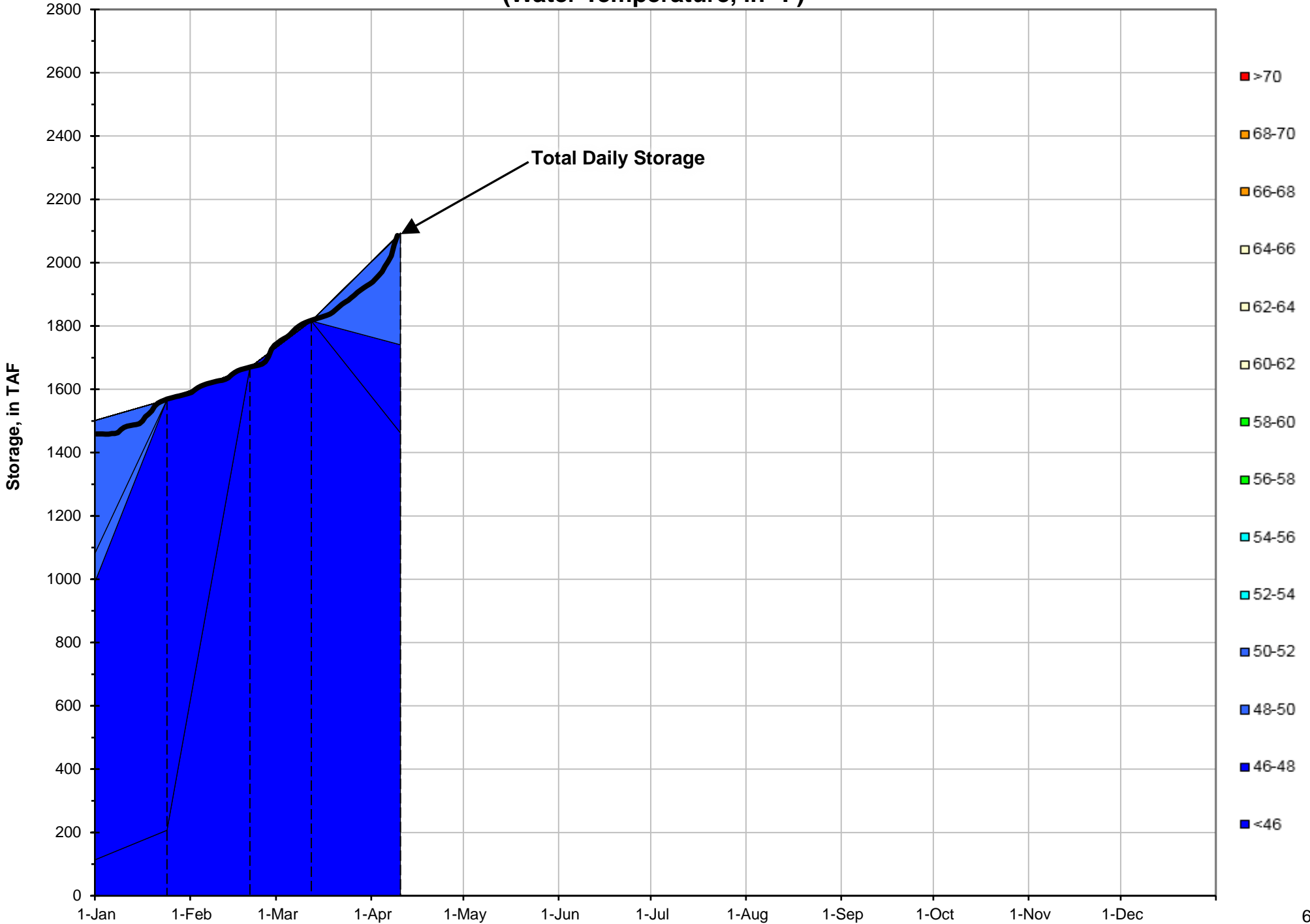
² DAT = Daily Average
Temperature



Shasta Lake Isothermobaths - 2019 (Water Temperature, in °F)



Trinity Lake Isothermobaths - 2019
(Water Temperature, in °F)



Whiskeytown Lake Isothermobaths - 2019

(Water Temperature, in °F)

